

The *Unofficial* Fusion for Apple Silicon Companion Guide

*The manual that VMware didn't publish...
and the one that you will need.*

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1 Introduction

Knowledge is good.

*– Inscription on the statue of Emil Faber at Faber College,
from the film “Animal House”*

The Unofficial Fusion for Apple Silicon Companion Guide (the “Companion Guide”) is an unofficial addition to the VMware Fusion documentation. It contains a collection of useful tips and techniques for building and running virtual machines under Fusion 13.5 on Apple Silicon (M1/M2) Macs. These tips were submitted by users on the VMware Fusion Discussions forums.

The Companion Guide may contain hyperlinks to external web sites. It is best viewed in Adobe Reader or any other PDF viewer. It can be printed for reference if desired (URLs to external web sites are visible in their entirety).

1.1 This guide is an unofficial publication

The Companion Guide is not a VMware official publication and is not endorsed by VMware. Its content is sourced from user posts in the VMware Community forums for VMware Fusion.

While every effort has been made to ensure the accuracy of content contained in the Companion Guide, no guarantees or warranties of accuracy are offered by either the editor or VMware. The editor’s intent is to keep the Companion Guide as accurate as possible so that it is useful to the broader community. Any inaccuracies should be reported to the Fusion forums, and they will be addressed in future versions of this document.

1.2 This guide requires Fusion 13.5 for Apple Silicon Macs

The Companion Guide is written to be used with Fusion 13.5 on Apple Silicon Macs. Users of older versions of Fusion need to install or update to Fusion 13.5 before using this Guide.

The Companion Guide does not cover Fusion running on Intel Macs. Users are more likely to need assistance with Fusion on Apple Silicon (M1/M2/M3) Macs than on Intel Macs because of the relative newness of arm64 operating systems and the changes to macOS introduced by Apple’s decision to switch from Intel CPUs to Apple Silicon.

1.3 “Some assembly is required” when using this guide

Some of the procedures in this Guide can be categorized as “some assembly required”. They require system administration or other “command line” (non-GUI) operations to complete the tasks. The Companion Guide tries to walk you through the procedures in as straight-forward a manner as possible without the need to be an expert programmer or system administrator to complete the tasks.

If you are unsure about how to perform these tasks, please post a question in the VMware Fusion Discussions forum. You are also encouraged to search the web for documentation and tutorials on your operating system environment.

1.4 Document conventions

Any references to “Fusion” in this document refer to Fusion 13.5 running on Apple Silicon Macs, unless otherwise noted.

Command input to a command prompt or “shell” (macOS Terminal/zsh shell, Linux bash shell, Windows cmd.exe or PowerShell) appears as follows

```
command arg1 arg2
```

If a command is too long and can’t fit on one line, it appears as follows:

```
command this command is too long\  
and continues here
```

The command can either be manually typed into the “shell” as one line by leaving out the backslash (but typing in any spaces at the beginning of the continuation line if present):

```
command this command is too long and continues here
```

Or you can copy/paste the two lines in their entirety into the “shell” The shell honors a backslash immediately preceding a line return/enter key as a continuation of the command.

Command output or text that a procedure asks to be included in files will appear as follows:

```
Output line 1  
Output line 2
```

1.5 Acknowledgements

The content of the Companion Guide is the work of the many Fusion community members that have contributed these valuable tips. Many thanks go out to those whose efforts make it possible. Apologies to anyone that I may have missed.

Special thanks go out to:

- @Mikero (Michael Roy, VMware Fusion/Workstation product manager) – for providing the Tech Preview, its documentation, and for keeping watch over the Discussions forum.
- @ColoradoMarmot – For comments and experiences on using prior versions of the Tech Preview, a heads-up on running multiple virtualization products at the same time.
- @palter – for noting that UTM 4.0 now enables virtualization of macOS Monterey and Ventura.
- @JamesRule – for reporting issues with resizing Kali Linux windows
- @adf43r3rfe – for reporting issues in booting a newly installed Kali Linux VM
- @mvreijn – for pointing out an omission of instructions for installing openSUSE Leap
- @toce – for pointing out an error in earlier versions of the commands used to install a Debian backport kernel that results in installation failures,
- @treee – for pointing out inaccuracies in revision 2 of this document, and suggesting changes for clarity

- @itris666 – for pointing out that Fusion Player does not have the ability to change Secure Boot state in the GUI once a Windows 11 ARM VM is created.
- @gnttz79xro – for a solution to stuttering sound on Linux virtual machines.
- @neanti – for a procedure to manually convert a Parallels VM to Fusion
- @itris666 – for returning the Windows Insider VHDX conversion procedures to the Companion
- @joedec – for solution to Windows 11 screen flickering/black display problem.
- @gringley – for reporting the availability of updated VMware Tools that address 2 security issues.
- @coolryg – for the explanation of devices that have no drivers in Windows 11 ARM VMs.

2 General Notes

2.1 Getting help

If you need help, the first place to start is the Fusion documentation. The topic [Location of Fusion documentation](#) will guide you to where you can find the available documentation.

If that doesn't help, search the VMware Fusion Community forum: <https://communities.vmware.com/t5/VMware-Fusion/ct-p/3005-home> and post a question if you can't find an answer. The VMware Fusion Community forums are a user-to-user forum where we try to help each other out.

Tips:

If you search the Internet and find a posting in either the “Fusion 2023 Tech Preview” forum or the “Fusion TP 22H2” forum, please do not post or reply there. Those old forums are for public beta test programs that have ended. They are not monitored for new content. Postings in those forums may also not be relevant to the current versions of Fusion. Instead, create a new post to the VMware Fusion Community forum using the above link.

Avoid “me too” and generalized “this happened to me” types of posts. You will get a better response to your question if you provide information about what's happening to you. Many issues seem the same but may have different causes.

Expect to provide in any post:

- the Mac hardware and macOS version that you're using
- the Fusion version you're running on
- the operating system (with version/build information) you're running in the VM
- a detailed description on what has happened (including how you got to the point of failure)

About the VMware Community forums

The VMware Community forums are user-to-user forums. People participating are end-users just like you. They respond based on their available time and expertise.

Knowledgeable and helpful people do frequent the forum, and are happy to assist – but remember that there are no guarantees on when or if someone responds to your question or that anyone knows an answer to your question.

Also remember that the forums are not an official VMware support site. VMware employees and technical support do not actively monitor the forums as part of their jobs. There should be no expectation that any problems with Fusion reported to the forums will be looked into by VMware. You may get the attention of a VMware engineer with a forum post, but consider yourself lucky if that happens.

To get a problem officially reported to VMware so that it can be fixed, open a Service Request through the VMware Customer Connect portal. You can open a Service Request for Fusion if:

- You have purchased a Fusion product license within the last 30 days. VMware offers complimentary Service Requests for 30 days after a Fusion license purchase.
- You have a VMware support contract for Fusion (uncommon for non-business users).
- You have purchased Fusion Pro per-incident support vouchers from the VMware Online Store.

2.2 Location of Fusion documentation

2.2.1 Release notes

It is strongly recommended that you review the release notes for Fusion before installing or upgrading Fusion. The release notes for Fusion 13.5 can be found at <https://docs.vmware.com/en/VMware-Fusion/13.5/rn/vmware-fusion-135-release-notes/index.html>.

2.2.2 Fusion documentation

The documentation for Fusion is available in-product, in HTML format on the Internet, and as a PDF document. To find the Fusion documentation:

- In-product - Select **Help > VMware Fusion Help** from the Fusion menu bar
- HTML format on the web - browse to: <https://docs.vmware.com/en/VMware-Fusion/13/com.vmware.fusion.using.doc/GUID-F2874B79-A32A-4B83-914F-9838372D47CD.html>
- PDF format - <https://docs.vmware.com/en/VMware-Fusion/13/fusion-13-user-guide.pdf>

2.3 Review VMware KB article 90364

VMware KB article “**Compatibility considerations for Arm guest operating systems in Fusion VMs on Apple silicon**” <https://kb.vmware.com/s/article/90364>. This article describes in more detail:

- The generic requirements and limitations for all ARM guest operating systems
- Detailed information on the virtual hardware devices for officially supported ARM guest operating systems, and
- Operating systems that are NOT supported by Fusion on Apple Silicon Macs. This includes a statement that NO x86 (Intel) operating systems and NO macOS versions are supported.

The information in this KB article is an important addition to the official Fusion documentation.

2.4 Obtaining installation media for guest operating systems

VMware does not provide pre-built virtual machine images for any guest operating system. You must download installation media and install it into a Fusion VM like you would for a physical machine. Here's how to obtain installation media.

2.4.1 Linux

Download arm64 ISO installation media for the Linux distribution of your choosing from the distribution's web site.

Tip: Make sure any Linux installation ISOs you download are for arm64 or aarch64 system architectures, and not for a Raspberry Pi. If it's anything else, it won't work.

2.4.2 Windows 11 ARM

Starting with Fusion 13.5, VMware provides a tool that downloads Windows 11 ARM installation media directly from Microsoft. See the topic [Obtaining Windows 11 ARM ISO installation media](#) for more details.

2.5 Update to Fusion 13.5

Fusion 13.5 is a free update to Fusion 13 users. It is recommended for Apple Silicon Mac users. It includes the following features that are not present in Fusion 13.0 through 13.0.3:

- macOS 14 Sonoma support
- Dramatically improved copy/paste/drag/drop speed for all guest operating systems
- Improved VMware Tools Setup installer for Windows 11 ARM (goodbye to the Powershell script to install VMware Tools)
- Copy/paste/drag/drop for Windows 11 ARM guests
- 3D graphics acceleration with DirectX 11 support for Windows 11 ARM guests
- Soft power operations (including suspend) for Windows 11 ARM guests
- Tool to download Windows 11 ARM installation media directly from Microsoft.

It's time to stop using the Tech Previews. Really. Now.

Now that Fusion 13.5 is officially released, stop using the 2023 Tech Preview.

Why?

- Fusion 13.5 contains all the features that were previewed in the 2023 Tech Preview (as well as older 21H1 and 22H2 Tech Previews). Plus some.
- Tech Previews are designed for users to test pre-release versions of software and provide feedback to VMware. Beta tests don't last forever, though. For the 2023 Tech Preview, the beta testing period ended the minute Fusion 13.5 was released.
- Tech Previews have known bugs and security vulnerabilities that are fixed in the released versions.
- Tech Previews are totally unsupported by VMware. If you have a problem with them, the first response from anyone (in the Fusion forums or from VMware Support) will be to upgrade to Fusion 13.5.
- You won't get help for Tech Previews by posting in the Tech Preview discussion forums. Those forums are either locked or not monitored actively.

There's no reason to keep using Tech Previews. Upgrade.

2.6 Run your VMs on local APFS or HFS+ volumes

You should store your VMs on disk volumes formatted with macOS Extended (HFS+) or APFS file systems. You will have problems trying to run Fusion virtual machines stored on:

- Read-write NTFS formatted file systems using third-party file systems such as Paragon NTFS
- FAT (MS/DOS) formatted USB sticks or hard drives
- Devices formatted with ExFAT file systems

These file systems either don't provide the file system operations that Fusion needs, or the third party file system drivers are problematic. The reported issues range from Fusion errors to corrupted virtual machines to macOS crashes.

It's also not recommended to run virtual machines from networked (NAS) storage. Aside from potential performance issues, one network interruption on your Mac and **poof** you may be faced with a virtual machine crash and a potentially corrupted virtual machine.

Just because you can't run a VM on NTFS, FAT, ExFAT, or networked file systems doesn't mean you can't use them. All available read-write file system types on the Mac can be used to transport VMs to/from another system or to provide a backup copy of your VM¹.

2.7 Don't sync your VMs to the cloud

Avoid storing and running your VMs in locations on disks that are configured to use cloud storage. This includes but is not limited to:

- Microsoft OneDrive
- Dropbox
- iCloud Drive
- Google Drive

Running your VMs from folders that use cloud storage may result in errors or corrupted virtual machines. Most of these solutions use Apple's File Provider services, and Fusion has no knowledge of where the files are stored or when they may be synchronized or evicted to the cloud. Some file system operations that Fusion wants to use may not work as expected, resulting in errors. You may also be waiting for the cloud to restore a multi-gigabyte file over the network that has been evicted from your disk without Fusion's knowledge.

Be wary of iCloud Drive

You may be syncing your Desktop and Documents folders to the cloud and not realizing it. Check your macOS **System Settings/System Preferences > Apple ID > iCloud > iCloud Drive**. If iCloud Drive is enabled, you should also see an option for "Desktop & Documents Folders". If that's enabled you are syncing your Desktop and Documents folders to iCloud. If that's what you want, you should not store your VMs in your Desktop or Documents folder (or their subfolders) for the reasons noted above. Or, turn the option off – and you're free to store your VMs in either folder.

2.8 Do not disable macOS security features

System Integrity Protection (SIP) and Apple Mobile File Integrity (AMFI) are two features that macOS provides to protect against malware. They are both enabled by default and never recommended to be disabled by Apple.

Users that have disabled these features have reported that VMs fail to run with the error message "Transport (VMDB) error -14 Pipe connection has been broken".

Do not disable either of these features and expect Fusion to run. VMware does not test and will not address problems with systems where they are disabled.

¹ Note that FAT formatted volumes have a maximum file size of 4 GB. You won't be able to use them to transport virtual machines with non-split virtual disks of 4 GB or larger. Use ExFAT instead.

2.9 Fusion on Apple Silicon does not run Intel virtual machines

As stated in KB article <https://kb.vmware.com/s/article/90364>, virtual machines built with Intel 32- or 64-bit operating systems will not run on Fusion on Apple Silicon Macs.² Parallels running on Apple Silicon Macs has the same behavior.

Intel Mac users with VMs other than macOS (including versions of Windows client before Windows 11 and all Windows Server versions) should consider:

- Continuing to run VMs on an Intel Mac.
- Using an Intel/AMD PC to run VMs with VMware Workstation³
- Using an Intel CPU emulator such as QEMU or UTM. Be aware that the performance of emulated Intel CPUs may not be acceptable.
- For the more technically inclined, using a computer with an Intel/AMD CPU to run VMs with the free version of the VMware ESXi hypervisor⁴.

Intel Mac users with macOS VMs should refer to the topic [macOS virtualization is not supported by Fusion on Apple Silicon](#) for guidance.

2.10 Features not available in Fusion 13.5 on Apple Silicon

Features not available in Fusion 13.5 on Apple Silicon (all guest operating systems)	
<ul style="list-style-type: none">• Running of virtual machines requiring Intel x86 or x64 CPUs• Virtualization of any version of macOS• Virtual machine import/export using .ova or .ovf formatted files	<ul style="list-style-type: none">• Virtual Printer (ThinPrint) sharing with the host Mac (workaround available)• Conversion of virtual machines from Parallels (workaround available)• Nested virtualization

In addition, please refer to the VMware KB article “Features of Windows 11 VM on Mac with Intel vs. Apple silicon (95031)” <https://kb.vmware.com/s/article/95031>. This article compares the features available for Windows guest operating system in Fusion 13.x for Intel Macs, Fusion 13 for Apple Silicon, and Fusion 13.5 for Apple Silicon.

² While Rosetta 2 allows applications compiled for Intel Macs to run on Apple Silicon CPUs, it does not enable hypervisors to run Intel operating systems. This is a documented Apple restriction.

³ VMware does not support or allow macOS VMs to run on VMware Workstation. Apple’s macOS licensing prohibits the use of macOS on non-Apple hardware.

⁴ VMware does not support macOS VMs when running ESXi on non-Apple hardware. macOS VMs are only allowed by Apple’s macOS licensing when running ESXi on Apple hardware.

2.11 Arm64 operating systems known to work on Fusion

This is not a comprehensive list.

Arm64 guest operating systems known to work with Fusion 13	
<ul style="list-style-type: none">• AlmaLinux 9.1 and later• CentOS 9 Stream• Fedora 38, 39, and Rawhide• Debian 11.7, 12• Kali Linux 2022.3 and later• OpenSUSE Leap 15.5	<ul style="list-style-type: none">• OpenSUSE Tumbleweed• Oracle Linux 8.7, 9.1 and later• Red Hat Enterprise Linux 9.1 and later• Ubuntu 20.04.5, 22.04.3, 23.04, 23.10• Windows 11 ARM 22H2 and later

It's recommended to use the latest releases of any Arm64 architecture operating system. As vendors gain experience with Arm64 CPUs, they have improved both the stability and performance of the operating system.

Some end-of-life/unsupported versions of the operating systems in the list may also work. Refer to the distribution-specific sections of the Guide to see if those EOL versions are usable – but note that EOL versions contain the risk of unpatched security issues.

VMware has implemented a “standard” virtual hardware environment that is certified to ARM System Ready specifications. Arm64 Linux distributions that have ISO installation media with reasonably current kernels (5.19 and later) and support the hardware described in the KB article <https://kb.vmware.com/s/article/90364> will likely work with Fusion. You are encouraged to try them and report your experiences back to the broader Fusion community.

2.12 Arm64 operating systems that won't work on Fusion

Operating system versions older than those listed in [Arm64 operating systems known to work on Fusion](#) **may not work**. Older distributions may contain kernels (especially those that have kernel versions older than 5.14) that have bugs and other incompatibilities that render them unusable on Fusion.

Linux installers and images targeted for Raspberry Pi arm64 single-board computers will not work on Fusion. Fusion does not provide virtual hardware for the storage, GPU, and boot firmware present on Raspberry Pi devices.

2.13 Linux 3D graphics acceleration

Fusion supports OpenGL 4.3 for 3D accelerated graphics on arm64 Linux virtual machines through the Mesa 3D libraries. Fusion does not currently support Vulkan.

3D acceleration for an arm64 Linux VM on Fusion requires:

- Virtual hardware version of 20 or later. Fusion 13.5 creates all new virtual machines with virtual hardware version 21.
- A VM with a 5.19 or later Linux kernel. These versions contain the VMware graphics driver enhancements needed to support 3D acceleration on arm64 virtual machines.
- Mesa 3D 22.1.1 or later installed in the VM.

3D acceleration is known to work on the following arm64 Linux distributions:

- Ubuntu 22.04.2 LTS and 22.04.3 LTS (when running the HWE kernel)
- Ubuntu 22.10 and later
- Fedora 37 and later
- Fedora Rawhide
- Debian 12 “bookworm”
- OpenSUSE Tumbleweed snapshot 20230403 and later
- Kali Linux 2023.1 and later

3D acceleration will not work on the following arm64 Linux distributions:

- Ubuntu 22.04.x LTS with 5.15 standard kernel
- Ubuntu 20.04.x
- Red Hat Enterprise Linux - all versions and all downstream derivatives such as Rocky Linux and AlmaLinux.
- Oracle Linux – all versions
- CentOS 9 Stream
- Debian 11 “bullseye”
- OpenSUSE Leap 15.x

Do not enable 3D acceleration on guests that do not meet the prerequisites. There have been reports of Fusion crashing early in the boot process when 3D acceleration is enabled for distributions that do not support it.

2.14 Some arm64 Linux installers do not boot on Fusion

Some older arm64/aarch64 installation ISOs may not boot on Fusion. They will display a blank screen with either no cursor or a static non-blinking cursor.

A common cause of this problem is a Linux kernel that contains an older version of the VMware SVGA virtual graphics driver (vmwgfx). This driver appears to have issues when running under Fusion.

See if the installer has an option to boot with a generic graphics adapter. If it doesn't, try disabling the vmwgfx driver at boot time using the following procedure so that the kernel will not load it. In some cases, this will allow the installer or virtual machine to boot using the default Linux framebuffer graphics driver.

1. Boot the virtual machine to the GRUB boot loader menu and use the keyboard up/down arrow keys to highlight the desired kernel.

Do not press **‘Enter’**. Instead, press **‘e’**. This will display the details of the GRUB booting commands for that kernel.

2. See the documentation for GRUB and your distribution for complete instructions on how to block kernel drivers from loading.

For many non-Debian Linux distributions, adding the following to the kernel arguments will prevent the vmwgfx driver from loading:

```
modprobe.blacklist=vmwgfx
```

For Debian-derived releases (including Kali Linux), add the following instead:

```
module_blacklist=vmwgfx
```

3. Press **Control-x** to boot the kernel with the updated arguments.

The kernel should now boot to the graphical login screen or installer. If it doesn't, the VMware graphics driver may not be the problem and additional troubleshooting needs to be performed.

2.15 Use open-vm-tools with arm64 Linux

The Fusion GUI menu item to “Install VMware Tools” is greyed out for arm64 Linux VMs. That's because VMware doesn't provide VMware Tools installable packages as part of Fusion for arm64 Linux.

open-vm-tools are the VMware-recommended in-guest tools for all current Linux operating systems and are the only in-guest tools available for arm64 Linux VMs. These tools are provided by the operating system vendors, not VMware. Install both open-vm-tools and open-vm-tools-desktop packages from the distribution's repositories where available.

2.16 “Start pxe over ipv4” message displayed during guest power up

“Start pxe over ipv4” is a message displayed when the guest is attempting to boot from a network interface. In almost all cases, this means that the guest cannot find a bootable operating system from either the hard disk or the CD/DVD drive.

If this message appears, check to see if one of the following has occurred:

Cause	What to do
The virtual CD/DVD drive is not configured to use the installation ISO.	Configure the installation ISO to the virtual CD/DVD drive and connect the drive to the guest.
The virtual CD/DVD drive is not connected to the guest.	Connect the virtual CD/DVD to the guest and restart the guest.
Corrupt or invalid ISO file.	Verify that you have installation media that contains a bootable ARM architecture operating system.
Trying to install from ISO installation media that is built for use on 32 or 64-bit Intel PCs.	Ensure you have arm64/aarch64 architecture ISO installation media for your operating system.
When installing Windows 11 ARM, the “Press any key to start from CD or DVD” prompt timed out.	<p>Restart the guest using the Fusion GUI. Immediately set keyboard focus to the virtual machine by either clicking the mouse in the VM’s console window or by pressing Command-G. Then press any key on the keyboard before the prompt times out.</p> <p>You may perform this action as many times as necessary until you get the Windows ISO installer to boot.</p>

2.17 Unable to change the display resolution of a Linux virtual machine

Changing the resolution of a Linux virtual machine display requires a Linux kernel that contains the VMware SVGA (vmwgfx) driver. VMware provided the vmwgfx driver to the Linux kernel source tree, and it should be included out-of-the-box in most vendor distributions with a 5.14 kernel or later.

Most of the time this issue is seen with Debian 11. The kernel that is released with Debian 11 is a 5.10 version which does not contain the VMware video driver.

2.18 Shared folders do not automatically mount in a Linux virtual machine

This is a known issue for Linux VMs using open-vm-tools on both x64 and arm64 operating systems. See the following VMware KB article for more information on why this occurs <https://kb.vmware.com/s/article/60262>.

The documented workaround for this issue is to disable and enable the Shared Folders feature of the virtual machine from the Fusion GUI while the VM is running. However, this workaround is not persistent, and must be repeated after each reboot of the virtual machine.

A persistent solution is to add an entry to `/etc/fstab` in the virtual machine that mounts the shared folders automatically on boot.

1. Log into the VM and sudo to root.
2. Verify the mount point directory `/mnt/hgfs` exists in the VM. If it doesn't, create the empty directory.
3. Edit `/etc/fstab`. Add the following line to the file:

```
vmhgfs-fuse /mnt/hgfs fuse defaults,allow_other,_netdev 0 0
```

4. Reboot the virtual machine

Shared folders configured in the Fusion GUI for the virtual machine should now mount at boot time.

Another persistent solution for distributions using systemd can be found in the following VMware Knowledge Base article: <https://kb.vmware.com/s/article/74650>.

2.19 Erratic behavior when multiple virtualization products are in use

(Thanks to @ColoradoMarmot for finding this)

Erratic behavior has been observed when running Fusion at the same time as running another virtualization product (in the reported case, Parallels). The issue reported is that host crashes have occurred when under heavy load.

A prudent practice would be to avoid running multiple virtualization products at the same time.

See this post for more details: <https://communities.vmware.com/t5/Fusion-22H2-Tech-Preview/Warning-about-running-multiple-hypervisors-at-once/td-p/2921430>.

2.20 Printing from virtual machines

It is not possible to share printers configured on the host Mac with guests using virtual printing (Thinprint) features. The features were never present for Fusion running on Apple Silicon Macs. VMware has not commented whether they will re-introduce the feature in a future release.

In the meantime, to print from a guest:

- If using Bridged networking, use the network printer configuration capabilities that are present in the guest. Versions of Linux and Windows that run on Apple Silicon can discover most reasonably modern networked printers available on your network.
- If using NAT networking, enable printer sharing on macOS for the printers you wish to use in the VM. The VM will be able to discover those printers with the guest operating systems' networked printing capabilities. This works for any printer configured to the Mac host.

2.21 Sound issues in Linux virtual machines

Some Linux distributions are reported to have issues playing sounds when run in a Fusion virtual machine. The reported issues usually include stuttering and lags of the sound output.

Many current Linux distributions have switched from using PulseAudio to pipewire for sound support. The distributions that have done this appear to be the ones that are exhibiting the issue.

@gnttz79xro reports that the issues can be fixed in Fedora 38 using the instructions in the article <https://gitlab.freedesktop.org/pipewire/pipewire/-/wikis/Troubleshooting#stuttering-audio-in-virtual-machine>. These instructions may be useful for other Linux distributions as well.

2.22 Copy/Paste/Drag/Drop on Linux VMs isn't working

If you find that copy, paste, drag, or drop is not working between your Linux VM and your Mac, check that the “open-vm-tools-desktop” package provided by your Linux distribution is installed in the VM. Many distributions will install automatically install the base “open-vm-tools” package but may not install “open-vm-tools-desktop” for you.

If you find that drag/drop of files between host and guest are not working, make sure you are running a Xorg (X11) session and not Wayland. Drag/Drop currently requires X11 as the windowing environment.

2.23 Fusion VMs on Sonoma will not boot if macOS VoiceOver is enabled

When running Fusion on macOS 14 Sonoma, virtual machines will not start when the macOS VoiceOver accessibility feature is enabled. They will power off immediately after they are started. The issue was uncovered during the Tech Preview and was reported to VMware development. VMware indicates that they are aware of this issue and are working on a solution.

Until VMware releases a fix for Fusion, consider one of these workarounds:

- Turn off VoiceOver.
- Don't upgrade to Sonoma until VMware fixes the issue. VoiceOver can be used with Fusion on Ventura as the issue does not occur on Ventura.

@RolandZi indicates that the 5th answer of the 2023 Tech Preview Discussions Forum thread <https://communities.vmware.com/t5/Fusion-2023-Tech-Preview/VM-shuts-down-seconds-after-powering-on-q...> also provides a workaround. Note that this workaround requires command line intervention and the enabling of the root account for macOS. It's not recommended unless you have the expertise.

2.24 Importing Parallels virtual machines

Fusion on Apple Silicon Macs does not implement the importing of virtual machines from Parallels. User @neanti provides a work-around for a Linux virtual machine that uses the qemu-img utility that is part of QEMU to perform a virtual disk conversion. This procedure was tested for a OpenSUSE Leap VM; it may work for other Linux distributions or for Windows.

1. Install qemu from either Homebrew or MacPorts
2. Clone the Parallels (so that all snapshots and Parallels guest tools can be removed without disturbing the existing VM)
3. Delete all VM snapshots in the clone.
4. Start the cloned VM and remove Parallels tools in the clone.
5. Turn off the VM.
6. Open a Terminal and cd to Parallels VM directory where the VM .hds file is located,
7. Convert the Parallels virtual disk to VMware vmdk format using the qemu-img command like the following:

```
qemu-img convert -f parallels pDisk.hds -O vmdk -o compat6 vDisk.vmdk
```

Where

- *pDisk.hds* is the input Parallels virtual disk, and
- *vDisk.vmdk* is the output converted VMware virtual disk

8. Create a new custom virtual machine in Fusion

Choose the appropriate guest OS version when prompted.

When asked for a virtual disk, opt to use an existing virtual disk. Pick the .vmdk file created from the qemu-img command above.

The new VM may not boot due to virtual hardware differences between a Parallels virtual machine and a Fusion virtual machine. But it will contain all settings and all apps from the previous installation.

If the VM fails to boot, use the Linux installer ISO for the distribution you initially used to install Linux on Parallels and boot it to rescue mode. You will then be able to fix any issues preventing the OS from booting. Sample instructions on how to perform this kind of repair for OpenSUSE can be found here: <https://forums.opensuse.org/t/repair-a-broken-uefi-grub2-opensuse-boot-scenario/129018>. Similar instructions may be able to be found for other distributions.

3 Arch Linux

Abandon all hope, ye who enter here.

– Dante, “Inferno”

3.1 General notes

The Fusion Community is reporting that the Arch Linux ARM port has not been successfully installed on Fusion. Unlike the Intel versions of Arch, the ARMv8 supported platforms and images for the Arch ARM port are either single-board computers (Raspberry Pi/ARM development boards) or Chromebooks. The installation images assume the hardware contains devices that are not provided by Fusion’s virtual hardware. For example, most of the supported boards have MicroSD cards, which Fusion does not provide.

Arch Linux ARM does not provide a port of open-vm-tools. That will limit the availability of Fusion features such as shared folders and copy/paste/drag/drop even if you can get it to run.

Unless you are an experienced developer and have lots of time on your hands, avoid Arch Linux on Fusion. And petition the Arch developers to port to a real ARM computer with NVMe disks.

4 CentOS 9 Stream

Note: This section discusses CentOS 9 Stream releases that are “upstream” from Red Hat Enterprise Linux. See the section [Red Hat Enterprise Linux and compatible/downstream distros](#) for discussion of CentOS Linux 8 and earlier versions that are re-spins (downstream versions) of Red Hat Enterprise Linux.

4.1 General notes

CentOS 9 Stream arm64 will install and run on Fusion.

- 3D acceleration is not available.
- open-vm-tools and open-vm-tools-desktop are both available from the CentOS repos.
- The console resolution can be changed (from within the VM and auto-fit when resizing the console window).

4.2 Creating a Centos 9 Stream VM

Choose “Red Hat Enterprise Linux 9 64-bit Arm” as the operating system type when creating the virtual machine. This recommended operating system type create a VM with 4 GB of memory, 2 CPUs and a 20 GB disk. Other operating system types such as “Other Linux 5.x Kernel 64-bit Arm” may not configure the VM with the minimum amount of memory or disk required for CentOS, resulting in the failure of the installation.

4.3 CentOS 8 Stream does not work

CentOS 8 Stream for arm64 does not work on Fusion. The kernels included in those releases are incompatible with the Apple Silicon hardware. They exhibit the same issue as noted in the topic [RHEL 8 and earlier do not work](#).

There is no workaround. Use CentOS 9 Stream instead.

5 Debian

5.1 General notes

Debian 11 “bullseye” 11.4 through 11.7 work on Fusion.

- 3D acceleration is not available.
- Resizing of the screen resolution is not available out-of-the-box. See the topic [Obtaining newer kernel versions for Debian 11](#) for a work-around.
- open-vm-tools and open-vm-tools-desktop are not in the standard repos. See the topic [open-vm-tools are now available in Debian repos](#).

Debian 12 “bookworm” works on Fusion.

- Console resolution change is supported (both from within the VM and auto-fit on console window resizing).
- 3D acceleration works.
- Open-vm-tools and open-vm-tools-desktop are available in the “bookworm” repos and are installed by default.

5.2 Creating a Debian VM

Either drag/drop of the ISO or custom virtual machine methods can be used.

For a Debian 11 VM, set the operating system type to “Debian 11.x 64-bit Arm”. For a Debian 12 VM, set the operating system type to “Debian 12.x 64-bit Arm”.

5.3 Obtaining newer kernel versions for Debian 11

Debian 11 on arm64 platforms ships with a 5.10 version of the Linux kernel. While this kernel works with Fusion, it does not contain a VMware virtual graphics adapter driver that will allow resizing of the console resolution.

Installing a 5.18 or later kernel from the “bullseye-backports” repository will allow the screen resolution to be changed. To access this repository, it must be added to the list of available repositories for installation. Full instructions on how to do this can be found at <https://backports.debian.org/Instructions>. A short version follows:

1. Open your terminal application and sudo to root.
2. Add the following line to /etc/apt/sources.list:

```
deb http://deb.debian.org/debian bullseye-backports main contrib non-free
```

3. Run the following command to update the available package information:

```
apt update
```

4. Run the following command to list kernels available for installation.


```
apt list 'linux-image'
```

Anything with "bullseye-backports" attached to the name is available from the backports repo.

5. Install a 5.18 or later kernel from the bullseye-backports repo. Example:

```
apt install linux-image-5.19.0-0.deb11.2-arm64/bullseye-backports
```

Note: be sure to specify the exact name of the package. A command such as

```
apt install linux-image-5.19.0-0.deb11.2/bullseye-backports
```

will attempt to install all variants of the given kernel and will result in an installation failure.

Tip: Kernels available in the bullseye-backport repository that are known to work include:

- linux-image-6.0.0-0.deb11.2-arm64/bullseye-backports
- linux-image-5.19.0-0.deb11.2-arm64/bullseye-backports
- linux-image-5.18.0-0.deb11.4-4-arm64/bullseye-backports
- linux-image-5.18.0-0.bpo.1-arm64/bullseye-backports

5.4 open-vm-tools are now available for Debian 11

Debian has made open-vm-tools and open-vm-tools desktop packages available for Debian 11 in the "bullseye-backports" repository.

To install open-vm-tools

- Add the "bullseye-backports" repository to `/etc/apt/sources.list` as noted in the topic [Obtaining newer kernel versions for Debian 11](#).
- Install the open-vm-tools packages from the backports repository. Here's an example:

```
apt install -t bullseye-backports open-vm-tools open-vm-tools-desktop
```

Best results have been reported when using open-vm-tools with a "bullseye-backports" 5.18 or later kernel.

5.5 Upgrading Debian 11 to Debian 12

Debian supports the in-place upgrading of an existing Debian 11 "bullseye" system to Debian 12 "bookworm". See the Debian 12 release notes for guidance on how to perform this upgrade.

Debian recommends that systems to be upgraded should remove packages installed from bullseye-backports repos before attempting the upgrade. If you have installed a kernel or open-vm-tools packages into a Debian 11 VM from using the information in this section, please remove them and revert the sources.list file to its standard contents before upgrading.

6 Fedora

6.1 General notes

Fedora 38, 39, and Rawhide will install and run with Fusion.

The following End-of-Life releases are also known to work with Fusion on Apple Silicon.

- Fedora 35 (EOL 2022-12-13)
- Fedora 36 (EOL 2023-05-16)
- Fedora 37 (EOL 2023-12-05)

Since EOL releases are no longer receiving updates for bug fixes or security issues, Fedora does not recommend their continued use.

For all these releases:

- The console resolution can be changed (from within the VM and auto-fit when resizing the console window).
- 3D acceleration is supported with Fedora 36 and later.
- open-vm-tools and open-vm-tools-desktop are available from Fedora repos. In most cases they'll be installed for you automatically.

6.2 Creating a Fedora VM

Either drag/drop of the ISO or custom virtual machine methods can be used. The guest operating system type will be automatically set to “Fedora 64-bit Arm” when using the drag/drop method.

7 Gentoo

Hic sunt dracones (Latin to English translation: Here be dragons)

– inscribed on the Hunt-Lenox Globe (c. 1504)

7.1 General notes

Gentoo for arm64 has been reported to install on a Fusion virtual machine. But note that it is somewhat experimental and not as polished as the other Gentoo supported architectures.

Use the arm64 Minimal Installation CD boot media to install Gentoo.

The Stage 3 archives containing systemd are known to work. OpenRC has not been tested at this time, but there should be no reason why it won't work.

There is no Gentoo Handbook for arm64. Use the Handbook for amd64 architectures as your guide.

When building a VM for Gentoo:

- Create a custom virtual machine. Do not drag/drop the ISO to create the VM.
- Set the virtual machine operating system to “Other 5.x Linux kernel 64-bit Arm”.
- Assign 2 cores and 4096 MB of memory to the VM.
- Create a virtual disk of 20 GB or more (40 GB if you are attempting to install a desktop profile with a GNOME or KDE desktop as 20 GB is insufficient for compilation of the packages).
- Assign the boot media ISO to the virtual CD/DVD drive and connect it to the virtual machine.

8 Kali Linux

“Il faut qu’il n’exige pas le secret, et qu’il puisse sans inconvénient tomber entre les mains de l’ennemi.” (Loosely translated: “the system must not require secrecy and must be able to be stolen by the enemy without causing trouble.”)

– Auguste Kerckhoffs (1883). “La cryptographie militaire”

8.1 General notes

Kali Linux (a Linux distribution containing tools for penetration testing and ethical hacking) arm64 versions run on Fusion.

- Console resolution can be changed from within the VM.
- Auto-fit of the resolution when resizing the console window does not work when using the default XFCE window manager. [See the topic Screen resolution fails to change when resizing the VM’s window.](#)
- 3D acceleration is supported.
- open-vm-tools and open-vm-tools-desktop are available from Kali repos.

Use Kali Linux 2022.3 or later releases. Earlier releases have issues with the bootable installer.

8.2 Creating a Kali Linux VM

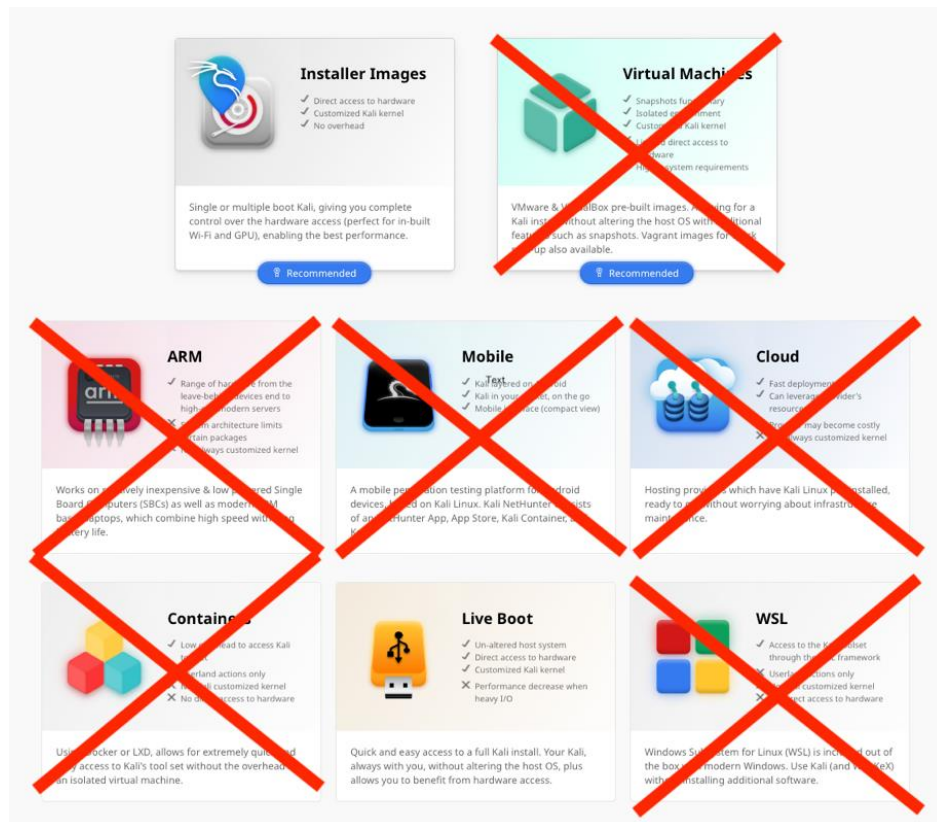
Either the drag and drop of the ISO onto the “Select the Installation Method” dialog or “Create a custom virtual machine” method can be used to create a Kali virtual machine from the installation ISO.

The recommended virtual machine configuration for Kali Linux is:

- Guest operating system type of “Debian 12.x 64-bit Arm” or “Other 6.x Linux kernel 64-bit Arm”
- 2 Virtual CPUs
- 4096 MB memory
- 20 GB virtual hard drive

8.3 Choosing the Kali installer

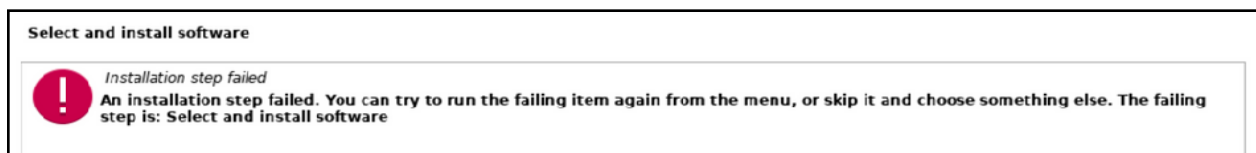
In the Kali download web site, use either **Installer Images** or **Live Boot** media. When downloading the media, be sure select media labelled for “Apple Silicon (ARM)”. Media labelled as “32-bit” or “64-bit” are for Intel CPUs.



Do not use any of the other platform types on this page on Apple Silicon Macs. They will not work.

8.4 Installation fails at “Select and install software”

If the installation of Kali Linux fails during the “Select and install software” phase with the following message:



check the size of your virtual hard drive. The installation will fail with this error message if there is insufficient space to install all the Kali software components. Typically, a 20GB virtual hard drive will allow the installation to complete successfully.

8.5 Screen resolution fails to change when resizing the VM's window

(Thanks to @JamesRule and @Mikero for reporting and explaining this)

Resizing the window of a Kali Linux VM will not change the console resolution. The console resolution can be changed within the VM, which will then change the window size.

According to @Mikero, this is an issue with the XFCE window manager that Kali uses by default. The console resolution will change when resizing the VM's window in KDE, GNOME, and Cinnamon, but not XFCE.

You can't get there from here.

– US New England regional idiom

9.1 Fusion on Apple Silicon does not run macOS VMs

Per VMware KB article <https://kb.vmware.com/s/article/90364>, Fusion on Apple Silicon does not support virtualization of any macOS version.

If you want to run a VM with any macOS version that runs on an Intel Mac, you must use Fusion on an Intel Mac⁵.

There are no options to virtualize macOS 11 Big Sur on an Apple Silicon Mac.

To virtualize macOS 12 Monterey and later releases on an Apple Silicon Mac, your options include:

- UTM (<https://mac.getutm.app>), free from the website or \$9.99 from the Mac App Store. Both versions are functionally identical, but the App Store version provides automatic updates and a donation to the author to fund future development.
- VirtualBuddy (<https://github.com/insidegui/VirtualBuddy>), open source, free. You don't have to build it, there is an installer for a pre-built application available on the web site.
- Parallels Desktop, commercial product, paid.

These products all use Apple's high level Virtualization Framework and have identical capabilities for macOS virtualization. They also all share the following restrictions imposed by Apple's framework:

<ul style="list-style-type: none">• No virtualization of macOS 11 Big Sur• No resizing of virtual disks• No virtual disk snapshots• No drag/drop of files between host Mac and VM	<ul style="list-style-type: none">• No passing of USB devices to the VM• No ability to sign in with an Apple ID in the VM• No more than 2 macOS VMs can run at once
--	---

VMware has stated that they are working on a full-featured virtualization solution for macOS on Apple Silicon but has not committed to when it will be released.

⁵ Apple's EULA for macOS prohibits the use of macOS on non-Apple hardware. VMware does not support macOS VMs on non-Apple hardware. They also do not allow discussions of running macOS on non-Apple hardware on their VMware Community forums.

10 OpenSUSE Leap

10.1 General notes

OpenSUSE Leap (“Leap”) version 15.5 is recommended for use in Fusion VMs. Leap 15.3 and earlier have reached their End-of-Life dates and no longer receive any updates. OpenSUSE recommends that they should not be used. Use Leap 15.5.

Leap 15.4 will work in a Fusion VM but installers may hang at “Starting udev”. The Appendix B topic [Leap 15.4 installer hangs at “Starting udev”](#) contains a workaround to this issue. Since Leap 15.4 is scheduled for EOL on 202-12-31, it’s recommended that you install or upgrade to Leap 15.5.

For Leap 15.4 and 15.5:

- Console resolution can be changed (from within the VM and via auto-fit when resizing the VM’s window).
- No 3D acceleration support.
- open-vm-tools and open-vm-tools-desktop are available from Leap repos.

10.2 Creating a Leap VM

When creating a new Leap VM, do not drag and drop the arm64 Leap installation ISO onto the Fusion “**Select the Installation Method**” dialog. If you do, an error message stating that the virtual machine requires an x86 machine architecture is displayed. The resulting VM will not be created correctly, and the VM won’t run.

Use the following procedure to create and install a Leap VM:

1. From the Fusion GUI menu bar, select **File > New**.
2. In the “**Select the Installation Method**” dialog:
 - Click on “**Create a custom virtual machine**”.
 - Click “**Continue**”.
3. In the “**Choose Operating System**” dialog:
 - Select a Linux operating system of “**Other Linux 5.x kernel 64-bit Arm**”.
4. In the “**Choose a Virtual Disk**” dialog:
 - Accept the default answer to create a new virtual disk.
 - Click “**Continue**”.
5. Select a name for the new virtual machine and save it.
6. The “**Settings**” dialog for the new virtual machine will appear. Make the following changes:
 - **Processors and Memory:** 2 virtual processors and at least 2048 MB of memory.

- **Hard Disk (NVMe):** Increase the disk size to at least 20 GB.
 - **CD/DVD (SATA):** Configure the virtual CD/DVD device to use the OpenSUSE Leap installation ISO and check the “**Connect CD/DVD Drive**” checkbox.
7. Power on the virtual machine to start the installer

11 OpenSUSE Tumbleweed

11.1 General notes

OpenSUSE Tumbleweed (“Tumbleweed”) is a continually updated or rolling distribution. It is released as “snapshots”⁶. See the Tumbleweed documentation for a more detailed explanation of how Tumbleweed is released and updated.

Tumbleweed arm64 will install and run on Fusion.

- Console resolution can be changed (from within the VM and via auto-fit when resizing the VM’s window).
- 3D acceleration is supported.
- open-vm-tools and open-vm-tools-desktop are available from Tumbleweed repos.

11.2 Creating an OpenSUSE Tumbleweed VM

A Tumbleweed VM can be created by dragging/dropping the installation ISO on the Fusion “**Select the Installation Method**” dialog.

Configure the VM as follows:

- Set the operating system type for the VM to “Other Linux 6.x kernel 64-bit Arm”.
- In the “Finish” dialog, click “Customize Settings” rather than “Finish”.
- Set the VM’s memory to a minimum of 4096 MB.
- Change the hard disk size to 20GB or more. This will give sufficient space for future upgrades.

You must change the memory and hard disk size before powering up the VM. Tumbleweed will not install with the default VM settings.

⁶ A Tumbleweed “snapshot” is not to be confused with Fusion’s ability to create a snapshot or point-in-time representation of its virtual disks. And we won’t even talk about the snapshots of a btrfs file system.

12 Oracle Linux

12.1 General notes

The only kernel Oracle provides for Oracle Linux on aarch64 (ARM) architectures is the Unbreakable Enterprise Kernel (UEK). The Red Hat Compatible Kernel (RHCK) is only available for x86_64 (Intel) architectures.

UEK R6 and earlier arm64 kernels will not run on Apple Silicon CPUs. The UEK R6 kernels have the same compatibility issues that prevent RHEL 8 from working. See the topic [RHEL 8 and earlier do not work](#) for more information. Oracle Linux versions 8.6 and earlier ship with these incompatible kernels and therefore will not work with Fusion.

UEK R7 arm64 kernels will run on Fusion. Oracle Linux arm64 versions starting with 8.7 (including all Oracle Linux 9.x versions) ship with UEK R7 kernels. These Oracle Linux versions will all run on Fusion.

12.2 Creating a Oracle Linux VM

When creating a VM for Oracle Linux, elect to create a custom virtual machine. Configure the virtual machine with:

- Operating system type set to “Other 64-bit Linux 5.x kernel 64-bit Arm”
- Minimum 2 virtual CPUs and 4096 MB memory
- Minimum virtual disk size of 20 GB

12.3 No open-vm-tools for Oracle Linux 8.7

Oracle does not provide open-vm-tools and open-vm-tools-desktop for Oracle Linux 8.7 in their repositories. No copy/paste/drag/drop is available between the host and guest, nor is there support for Fusion folder sharing between host and guest.

Both open-vm-tools and open-vm-tools-desktop packages are available in Oracle’s repositories for Oracle Linux 9.

13 Red Hat Enterprise Linux and downstream distros

This section also applies to RHEL downstream distros

References to Red Hat Enterprise Linux (RHEL) in this section also apply to “downstream” distributions that are re-builds of Red Hat Enterprise Linux such as:

- Rocky Linux
- CentOS Linux 8 and earlier (before the switch to CentOS Stream)
- AlmaLinux

Oracle Linux differs enough from RHEL to warrant its own discussion. See the section [Oracle Linux](#).

13.1 General notes

RHEL 9.1 and later arm64 releases provide the best experiences when running under Fusion.

- Console resolution can be changed (from within the VM and auto-fit when resizing the VM’s window).
- 3D acceleration is not supported.
- open-vm-tools and open-vm-tools-desktop are available from RHEL 9 repos.

RHEL 9.0 is not recommended. It will run but has installation issues which have been fixed in RHEL 9.1 and later.

13.2 Creating a RHEL 9 VM

Either drag/drop or custom virtual machine methods can be used to create a RHEL 9 VM.

When creating a RHEL 9 virtual machine, set the operating system type to “Red Hat Enterprise Linux 9 64-bit Arm”.

13.3 RHEL 8 and earlier do not work

Per VMware KB article <https://kb.vmware.com/s/article/90364>, RHEL 8 arm64 versions and earlier are not supported on Apple Silicon and will not work. Attempts to use these distributions will get into a “boot loop”. The kernel selected in the GRUB boot menu will fail to boot, and the GRUB boot menu will reappear.

This is caused by Red Hat’s decision to compile arm64 kernels for RHEL 8.x and earlier with a 64 KB page size. Apple Silicon CPUs only support 4 KB and 16 KB page sizes. This incompatibility makes these RHEL releases unable to run on Apple Silicon and Fusion.

No workaround is available to make these kernels boot. VMware has no plans or ability to make them work.

This issue is fixed starting with RHEL 9. Red Hat now compiles their ARM kernels with a 4 KB page size, which is compatible with Apple Silicon CPUs.

14 Ubuntu

I've got to admit it's getting better. A little better all the time (It can't get no worse).

– The Beatles, “Getting Better”

14.1 General notes

Ubuntu arm64 releases known to work on Fusion are:

- 20.04.5 LTS (Focal Fossa).
- 22.04.3 LTS (Jammy Jellyfish)
- 22.10 (Kinetic Kudu) – EOL, but works
- 23.04 (Lunar Lobster)
- 23.10 (Mantic Minotaur)

According to VMware KB article <https://kb.vmware.com/s/article/90364> earlier releases of Ubuntu arm64 are not supported and are generally known not to work. Their kernels have bugs and other deficiencies that prevent them from working properly on Fusion.

For Ubuntu 22.04.3 and later:

- Console resolution can be changed (from within the VM and auto-fit when resizing the VM's window).
- 3D acceleration is supported (22.04.3 needs to run HWE kernel).
- open-vm-tools and open-vm-tools-desktop are available from Ubuntu repos.

14.2 Creating an Ubuntu VM

Either drag/drop of the ISO or custom virtual machine methods can be used.

The operating system type will be automatically set to “Ubuntu 64-bit Arm”.

14.3 Where is Ubuntu Desktop for arm64?

Canonical did not provide GA versions of Ubuntu Desktop arm64 prior to 23.10. Starting with 23.10, Canonical released Ubuntu Desktop for Lenovo X13s Gen 1 ARM PCs. This ISO is an arm64 version of Ubuntu and will boot and install in a Fusion VM (with a slight tweak to the ISO boot process). See the topic [Links to Ubuntu downloads](#) for the download location, and the topic [Installing the Ubuntu Desktop image for Lenovo X13s Gen 1](#) for instructions on how to use this installer to install a Fusion VM.

For versions of Ubuntu earlier than 23.10, you may find that the arm64 daily desktop development builds found in the section [Links to Ubuntu downloads](#) will work for you. You can also install Ubuntu Server arm64 for any Ubuntu version and then “convert” it to an Ubuntu Desktop equivalent using the procedure in the topic [How to convert Ubuntu Server to Ubuntu Desktop](#).

14.4 Use the Ubuntu 22.04.3 LTS installer for a 22.04 VM

If you want to install Ubuntu 22.04 LTS in a Fusion virtual machine, use the arm64 installation ISO for 22.04.3 LTS or later. The installation ISOs for Ubuntu Server 22.04 LTS and 22.04.1 LTS will not boot on Fusion. The 22.04.2 ISO will boot with its standard 5.15 kernel, but the optional HWE kernel on the 22.04.2 ISO will not work properly on Fusion. Both these issues are fixed in the 22.04.3 and later installation ISOs.

14.5 How to convert Ubuntu Server to Ubuntu Desktop

By adding a few packages and making a configuration change, Ubuntu Server can be “converted” into the equivalent of Ubuntu Desktop. Use the following procedure to perform the conversion.

Credit: The process to convert the networking configuration from using `systemd.networkd` to NetworkManager was sourced from <https://www.configserverfirewall.com/ubuntu-linux/ubuntu-network-manager/>.

1. Boot the Ubuntu Server VM and log in.
2. Install the Ubuntu Desktop packages.

If you are running any version of Ubuntu, you can install the full set of Ubuntu Desktop packages using the following command:

```
sudo apt install ubuntu-desktop
```

If you are running Ubuntu 23.10 or later, you can install a minimal set of Ubuntu Desktop packages using the following command

```
sudo apt install ubuntu-desktop-minimal
```

3. Install `open-vm-tools-desktop`.

```
sudo apt install open-vm-tools-desktop
```

4. If you are running Ubuntu 23.04 or earlier, install Ubuntu Software from the Snap store using the following command:

```
sudo snap install snap-store
```

If you are running Ubuntu 23.10, install the new App Center with the following command:

```
sudo snap install snap-store -- channel=latest/stable/ubuntu-23.10
```

5. Disable the use of `systemd-networkd` for networking management.

```
sudo systemctl disable systemd-networkd.service
sudo systemctl mask systemd-networkd.service
sudo systemctl stop systemd-networkd.service
```

6. Save a copy of the `.yaml` file found inside the `/etc/netplan` directory.

```
cp /etc/netplan/*.yaml ./
```

7. Edit the `.yaml` file found inside the `/etc/netplan` directory (there should be only one, and its name may vary between Ubuntu releases). Use the editor of your choice; you will need to execute the editor with `sudo` as the `.yaml` file is owned by root.

Example using the `vi` text editor:

```
cd /etc/netplan
sudo vi 00-installer-config.yaml
```

8. Replace the entire contents of the `.yaml` file with the following:

```
network:
  version: 2
  renderer: NetworkManager
```

9. Set the system to use NetworkManager for networking management.

```
sudo netplan generate
sudo systemctl unmask NetworkManager
sudo systemctl enable NetworkManager
sudo systemctl start NetworkManager
```

10. Update boot files

```
sudo update-initramfs -u -k all
```

11. Reboot the VM

```
sudo systemctl reboot
```

Upon reboot, the VM should display a graphical login. Logging in will now start a graphical session.

14.6 Links to Ubuntu arm64 downloads

These links were verified as of 2023-11-05. They may change without notice.

Ubuntu Version	Download Link
20.04.5 LTS (Focal Fossa) Server	https://cdimage.ubuntu.com/ubuntu/releases/20.04.5/release/ubuntu-20.04.5-live-server-arm64.iso
22.04.3 LTS (Jammy Jellyfish) Server	https://cdimage.ubuntu.com/ubuntu/releases/22.04.3/release/ubuntu-22.04.3-live-server-arm64.iso
22.04 LTS (Jammy Jellyfish) Desktop daily development build	https://cdimage.ubuntu.com/jammy/daily-live/current/jammy-desktop-arm64.iso
22.10 (Kinetic Kudu) Server (EOL)	http://old-releases.ubuntu.com/releases/22.10/ubuntu-22.10-live-server-arm64.iso
23.04 (Lunar Lobster) Server	https://cdimage.ubuntu.com/releases/23.04/release/ubuntu-23.04-live-server-arm64.iso
23.10.1 (Mantic Minotaur) Server	http://cdimages.ubuntu.com/releases/23.10.1/release/ubuntu-23.10-live-server-arm64.iso
23.10.1 (Mantic Minotaur) Desktop for Lenovo X13s Gen 1	http://cdimages.ubuntu.com/releases/23.10.1/release/ubuntu-23.10.1-desktop-arm64+x13s.iso See the topic Installing the Ubuntu Desktop image for Lenovo X13x Gen 1 for installation instructions.
24.04 (Noble Numbat) Desktop daily development build	http://cdimages.ubuntu.com/daily-live/current/noble-desktop-arm64.iso Warning: It's early in the Noble development cycle. These builds may be unstable.

14.7 Installing Ubuntu Desktop for Lenovo X13s Gen 1

Canonical has released an Ubuntu Desktop 23.10 installation ISO for Lenovo X13s Gen 1 PCs. The Lenovo X13s Gen 1 is an ARM PC containing a Qualcomm Snapdragon ARM CPU.

This installer can be modified to boot on Fusion and will install Ubuntu Desktop 23.10 without the need to install Ubuntu Server and “convert” it.

To boot this installer on Fusion:

1. Create a new virtual machine by dragging and dropping the Ubuntu installation ISO on the “Select the Installation Method” dialog. Make any changes necessary and ensure that the virtual machine guest type is “Ubuntu 64-bit Arm”.
2. Power on the VM. The GRUB boot loader screen will appear:



3. Use the keyboard up/down arrows to select “**Try or Install Ubuntu**”. Then press “**e**” on the keyboard to edit the commands.

4. The following screen will appear with the default boot options for the installer.

```
GNU GRUB version 2.12~rc1

setparams 'Try or Install Ubuntu'

set gfxpayload=keep
linux /casper/vmlinuz clk_ignore_unused pd_ignore_unused layerfs-path=minimal.standard.live.squashfs --- quiet splash
initrd /casper/initrd
devicetree /casper/sc8280xp-lenovo-thinkpad-x13s.dtb
```

Use the keyboard arrow keys and the **Delete** key to move the cursor and remove the following kernel arguments (from the line beginning with “linux”):

```
clk_ignore_unused
pd_ignore_unused
layerfs-path=minimal.standard.live.squashfs
```

Additionally, remove the entire line that contains:

```
devicetree /casper/sc8200xp-lenovo-thinkpad-x13s-dtb
```

The boot commands should now look like this:

```
GNU GRUB version 2.12~rc1

setparams 'Try or Install Ubuntu'

set gfxpayload=keep
linux /casper/vmlinuz --- quiet splash
initrd /casper/initrd_
```

6. Press **Control-x** to boot the VM and the installer.
7. Install Ubuntu as you normally would.

14.8 Change delay for display of GRUB boot loader menu

The GRUB boot loader’s boot menu is useful in situations where a kernel update (or other circumstance) requires manual intervention to the Linux boot process. Ubuntu documentation describes how to display the GRUB boot loader menu during boot by pressing the “Esc” key immediately after boot and before the Ubuntu splash screen is displayed. However, the window is very short for the key to be recognized. Most people can’t get the process to work for them reliably.

The timing can be altered so that it delays the boot of the default kernel, giving you more of a chance for the “Esc” key to be recognized.

1. Log into the VM.
2. Sudo to a root shell, and edit `/etc/default/grub`:
3. Find the line containing

```
GRUB_TIMEOUT=0
```

and change it to

```
GRUB_TIMEOUT=5
```

GRUB_TIMEOUT is the delay (in seconds) until the default kernel is booted. During the delay, the boot menu can be entered by pressing the “Esc” key on the keyboard.

Tip: A delay of 5 seconds is typically sufficient. Longer delays can be specified if desired.

4. Save the changes and exit the editor.
5. Update the grub configuration:

```
update-grub
```

The GRUB boot menu will now give you 5 seconds to press the “**Esc**” key to display the boot menu. If no “**Esc**” key is pressed, the default kernel will boot.

15 Windows 11 ARM

15.1 General notes

According to VMware KB article <https://kb.vmware.com/s/article/90364>, Windows 11 ARM is the only version of Windows supported with Fusion on Apple Silicon Macs⁷.

Fusion provides the virtual hardware features required by Windows 11 (both UEFI Secure Boot and Trusted Platform Module) as well as Windows 11 ARM device drivers for the VMware virtual graphics and virtual network adapters.

Microsoft does not provide an ISO for Windows 11 ARM

Microsoft does not currently provide Windows 11 ARM ISOs for consumer download. Any media you obtain from Microsoft's web site will only work on 64-bit Intel/AMD PCs. Attempting to use these ISOs to create a virtual machine on Apple Silicon **will not work**.

Use the procedures in this section to obtain Windows 11 ARM installation media.

Fusion 13.5 contains a built-in tool to obtain ISO installation media for your Windows 11 ARM virtual machine. See the topic [Obtaining Windows 11 ARM ISO installation media](#).

Users of Windows 11 ARM virtual machines should install Fusion 13.5. Fusion 13.5 dramatically improves the user experience for Windows 11 ARM.

15.2 Features supported by Fusion for Windows 11 ARM guests

The VMware KB article “**Features of Windows 11 VM on Mac with Intel vs. Apple silicon (95031)**” <https://kb.vmware.com/s/article/95031> documents the features that are supported for Windows 11 ARM guest operating systems. The following notable features remain unsupported for Windows 11 ARM guests:

- Unity mode
- Shared folders (see [Fusion folder sharing with the Mac host is not supported](#) for a workaround)

⁷ Windows 10 ARM isn't supported, and users have failed to get it to work. It goes without saying that Windows 8, 8.1, 7, Vista, XP, NT, 98, 95, NT, and any Windows Server release won't run as these all require an Intel compatible CPU.

15.3 Windows 11 ARM licensing

Windows isn't free, folks

Windows is not a free product. Even though Microsoft will not stop you from running an unlicensed copy of Windows, please respect Microsoft licensing policies and (legally) obtain Windows 11 licenses for those Windows 11 ARM VMs that you run regularly in a Fusion VM.

Microsoft allows retail licenses for Windows 11 Home or Professional to activate Windows 11 ARM. Yes, this means you can use a license purchased for an Intel PC on Windows 11 ARM that is installed in a Fusion VM. If you don't have a license, purchase it from any Microsoft authorized seller (for your protection). You also can purchase a license directly from the Microsoft Store once the VM is running.

Windows 10 retail licenses can also be used to activate Windows 11 ARM.

Windows 11 ARM can be used without activation, but some features such as personalization are not available. You will also be nagged about having an inactivated copy of Windows. This is no different than running an inactivated copy of Windows 11 on an Intel PC.

15.4 Obtaining Windows 11 ARM ISO installation media

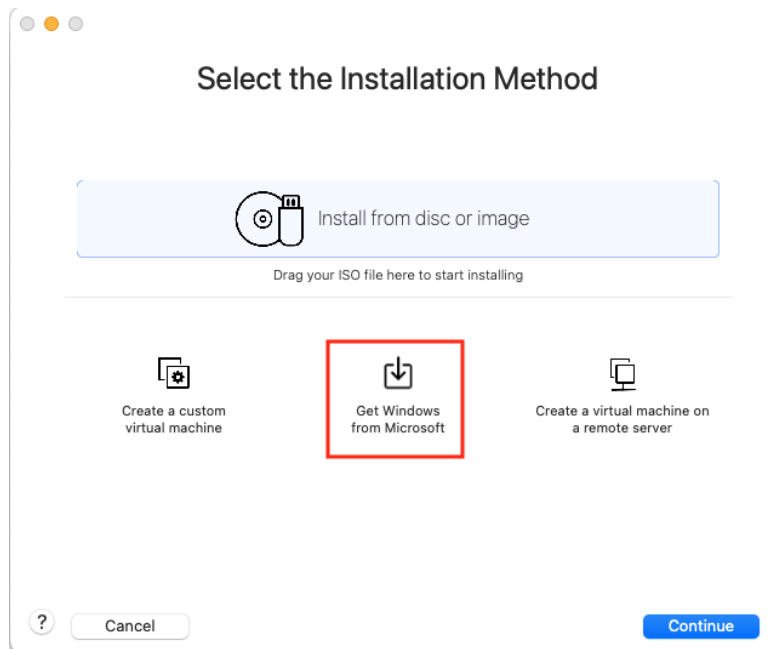
The Internet can be wrong about where to get Windows 11 ARM

The wonderful thing about the Internet is that there's a tremendous amount of information out there. The bad thing about the Internet is that obsolete, inapplicable, or incorrect information never gets deleted. And chances are that it will turn up in a search that you do today.

There are Internet videos and guides that will tell you that if you want to run Windows 11 ARM on Fusion, you should either build ISO media from uupdump.net or use Windows 11 Insider Preview VHDX files. That advice is woefully obsolete and will waste your time.

Install Windows 11 ARM from ISO media downloaded using the tool that VMware provides. If you require the use of Windows Insider builds to perform development testing with the next version of Windows, see the topic [Installing from Windows](#)

Fusion 13.5 includes an option in the **“Select the Installation Method”** dialog to download Windows 11 ARM installation media directly from Microsoft. The tool that VMware provides is easy to use and gives you the officially released version of Windows 11 ARM (currently 23H2) – not a preview release.



It is no longer necessary to use `w11arm_esd2iso`, `uupdump.net`, or `CrystalFetch` to create Windows 11 ARM ISO media.

Refer to the Fusion documentation for instructions on how to use the “Get Windows from Microsoft” option. Look for the topic **“Download and Install Windows 11 as Guest Operating System on Apple Silicon Macs”**.

The generated ISO is saved on your hard drive and can be reused for future Windows 11 ARM installations.

Tip: Ensure you have a minimum of 12 GB of free disk space on your Mac before creating the ISO media using the VMware tool.

Tip: If you are looking to install Windows 11 Home, choose the “Professional” edition in the VMware tool. The generated ISO will contain both Windows 11 Home and Windows 11 Professional.

Unlike other methods of generating Windows 11 ARM installation media, the Fusion-generated ISO contains the VMware graphics and network drivers for Windows 11 ARM. These drivers will be automatically installed into a new VM. This simplifies the installation of Windows 11 ARM as networking will be available for discovery by Windows Setup.

What if I have media created another way?

If you have existing Windows 11 ARM ISO media created by using `w11arm_esd2iso`, `CrystalFetch`, or `Parallels`, you can still use that media to install a Windows 11 ARM VM. Since these ISOs do not contain the VMware network and video drivers, you will need to do one of the following the first time the Windows Setup “Choose your country or region” prompt is displayed:

- Install VMware Tools so that networking can be found by Windows Setup. This is done by opening a command prompt with **Fn-Shift-F10**, mounting the VMware Tools installer, and executing the VMware Tools `setup.exe` utility manually, or
- Disable Windows Setup’s check for networking.

To avoid this extra work, rebuild your Windows 11 ARM ISO installation media using the tool bundled with Fusion 13.5.

15.5 Windows 11 download tool in Fusion GUI fails to create ISO

If the macOS system language is set to other than English, the “Get Windows from Microsoft” tool in the Fusion 13.5 GUI may fail to create an ISO.

The ISO can be created using the command line version of the tool. Use the following procedure to download the ISO until VMware fixes the GUI.

1. Open the Terminal app.
2. Change the working directory to the Desktop

```
cd ~/Desktop
```

3. Mount the ISO file containing the VMware Tools for Windows 11 ARM

```
hdiutil attach /Applications/VMware\ Fusion.app/Contents/Library\
/isoimages/arm64/windows.iso
```

The ISO will appear on the Desktop as “VMware Tools” and will be found at `/Volumes/VMware Tools`.

4. Download the ESD from Microsoft for the desired edition and language:

```
/Applications/VMware\ Fusion.app/Contents/Library/vmw_esd2iso \
getesd --edition "edition" --lang "tag"
```

where

edition is **Professional** for an ISO containing Home and Professional editions, or **Enterprise** for an ISO containing Professional and Enterprise editions.

tag is one of the Windows 11 ARM language tags used to select the desired language of the Windows installer:

<u>Tag</u>	<u>Language Description</u>	<u>Tag</u>	<u>Language Description</u>
bg-bg	Bulgarian (Bulgaria)	ko-kr	Korean (Korea)
cs-cz	Czech (Czechia)	lt-lt	Lithuanian (Lithuania)
da-dk	Danish (Denmark)	lv-lv	Latvian (Latvia)
de-de	German (Germany)	nb-no	Norwegian Bokmål (Norway)
el-gr	Greek (Greece)	nl-nl	Dutch (Netherlands)
en-gb	English (United Kingdom)	pl-pl	Polish (Poland)
en-us	English (United States)	pt-br	Portuguese (Brazil)
es-es	Spanish (Spain, International Sort)	pt-pt	Portuguese (Portugal)
es-mx	Spanish (Mexico)	ro-ro	Romanian (Romania)
et-ee	Estonian (Estonia)	ru-ru	Russian (Russia)
fi-fi	Finnish (Finland)	sk-sk	Slovak (Slovakia)
fr-ca	French (Canada)	sl-si	Slovenian (Slovenia)
fr-fr	French (France)	sr-latn-rs	Serbian (Latin, Serbia)
he-il	Hebrew (Israel)	sv-se	Swedish (Sweden)
hr-hr	Croatian (Croatia)	th-th	Thai (Thailand)
hu-hu	Hungarian (Hungary)	tr-tr	Turkish (Turkey)
it-it	Italian (Italy)	uk-ua	Ukrainian (Ukraine)
ja-jp	Japanese (Japan)	zh-cn	Chinese (Simplified, China)
		zh-tw	Chinese (Traditional, Taiwan)

The ESD file will be downloaded to your Desktop. Note its name as you will need it for the next step.

5. Create the ISO file from the ESD and include VMware video and network drivers (the drivers will be installed by Windows setup).

```
/Applications/VMware\ Fusion.app/Contents/Library/vmw_esd2iso \
generateiso --esd "esd-file" --drivers \
"/Volumes/VMware Tools/svgas,/Volumes/VMware Tools/vmxnet3"
```

where

esd-file is the name of the ESD file downloaded in the prior steps. Enclose the file name in double quotes if the name contains spaces.

The arguments to the **--drivers** option must be enclosed in quotes as noted above because they contain spaces in the file names.

The ISO file will be generated in the Desktop folder.

6. Clean up.

Unmount the VMware Tools ISO with the following command:

```
hdiutil detach "/Volumes/VMware Tools"
```

Use the Finder to delete the downloaded ESD file from the Desktop folder (don't forget to empty the Trash!). The ESD file is no longer needed. .

15.6 Creating the VM and installing Windows 11 from ISO

To create and install a Windows 11 ARM virtual machine, see the Fusion documentation for the topic “**Download and Install Windows 11 as Guest Operating System on Apple Silicon Macs**”.

The documentation contains a complete workflow for the installation of the Windows 11 ARM guest.

Tip: In the “**Choose Firmware Type**” dialog box, check the “**UEFI Secure Boot**” box.

Tip: In the “**Choose Encryption**” dialog box, choose “**Only the files needed to support a TPM**”

Tip: In the “**Choose Encryption**” dialog box, create your own password and store it in the password manager of your choice where you can retrieve it if you should ever have a problem with the macOS Keychain. VMware cannot retrieve a lost encryption password should you forget it.

Download all available updates from the Microsoft Store after installation. The first time the Microsoft Store is executed, it may take a few moments to open as it is being downloaded from Microsoft and installed. You can track the progress of this installation from the Windows notification widget found by clicking on the "bell" icon in the lower right-hand corner of the console screen to the right of the date and time display.

If

- the Microsoft Store doesn't seem to work properly after Windows installs (e.g., it crashes on open), or,
- “standard” Windows applications like Notepad have a small gray icon in the Start menu and won't launch, or
- the Microsoft Store can't be found on the VM and isn't automatically downloading

you may need to manually install the Microsoft Store app. See the topic [Microsoft Store app doesn't exist or crashes in a newly installed VM](#).

After installation of Windows 11 ARM, log in and install the complete VMware Tools package. See the topic [Installing VMware Tools on Windows 11 ARM](#).

Once Windows is installed and you've successfully logged in, run Windows Update to obtain the most recent updates for Windows 11. You may need to do this more than once.

15.7 Installing VMware Tools on Windows 11 ARM

Use the procedure in “Manually Install VMware Tools” found in the Fusion documentation to install or upgrade VMware Tools in a Windows ARM VM. However, **ignore the note for Windows on ARM**. You no longer need to use Powershell to install VMware Tools (As a matter of fact, you can’t use the procedure in the note at all with Fusion 13.5). VMware Tools for Windows 11 ARM in Fusion 13.5 install the same way that they do with Fusion on Intel Macs.

Tips:

You may get a Windows UAC prompt asking you to grant permission to VMware Tools setup to modify your system. Grant the permission.

If Autorun is not enabled, you can open a command prompt and start the setup as noted in the documentation. For Windows 11 ARM, the setup program is named D:\setup.exe instead of D:\setup64.exe.

In certain circumstances, you may need to move windows or use **Option-Tab** to see the VMware Tools Setup wizard.

When installing VMware Tools, select the “**Complete**” setup option.

15.8 Installing from Windows Insider Preview VHDX files

Windows Insider Preview releases are pre-release software

Most users should run the released version of Windows 11 ARM installed from ISO media. Use Insider Preview releases of Windows only if you need to perform development testing of future versions of Windows 11.

You will need to register for the Microsoft Windows Insider program in order to obtain these Windows Insider builds.

Windows Insider builds are pre-release builds. They do not have the same level of stability or support as Release or Retail channel Windows builds. In addition, there may be features in Insider Preview builds that may or may not make it into future Windows releases, or may appear in different forms.

To download and install Windows 11 ARM Insider Preview releases from VHDX files provided by Microsoft, use the following procedure.

1. Download the desired Windows 11 ARM Insider Preview VHDX file from the Microsoft Windows Insider site using the following link: <https://www.microsoft.com/en-us/software-download/windowsinsiderpreviewARM64>.

The Beta Channel release is typically the best choice as it will be updated through Windows Update. Other channels (Dev or Canary) will expire and may require you to perform a full re-installation when they expire.

2. In the Terminal application, change the working directory to the location where you downloaded the VHDX file.

Convert the VHDX file to VMDK format using the following command

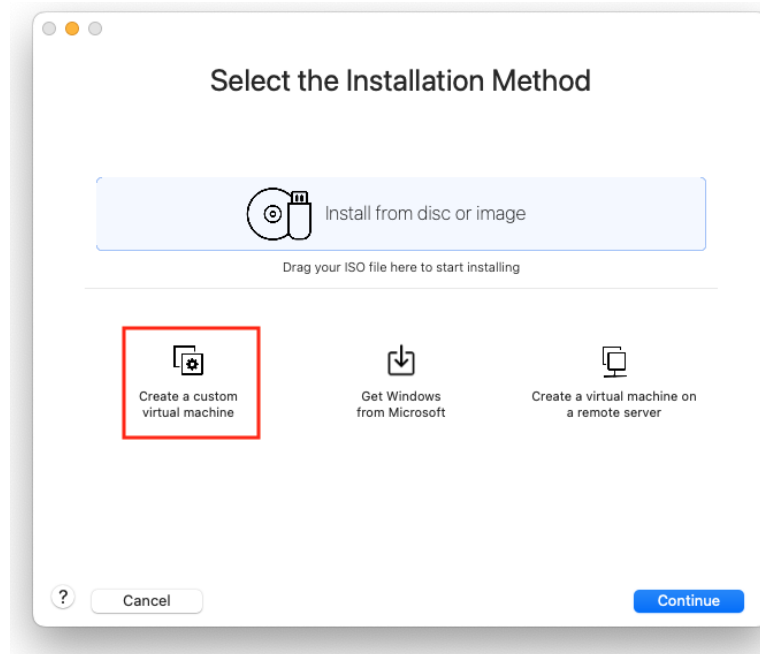
```
/Applications/VMware\ Fusion.app/Contents/Library/vmware-vdiskmanager \  
-r ./vhdx.VHDX -t 0 ./Windows11.vmdk
```

If you have installed QEMU, you may use the following command instead:

```
qemu-img convert -p -O vmdk ./vhdx.VHDX ./Windows11.vmdk
```

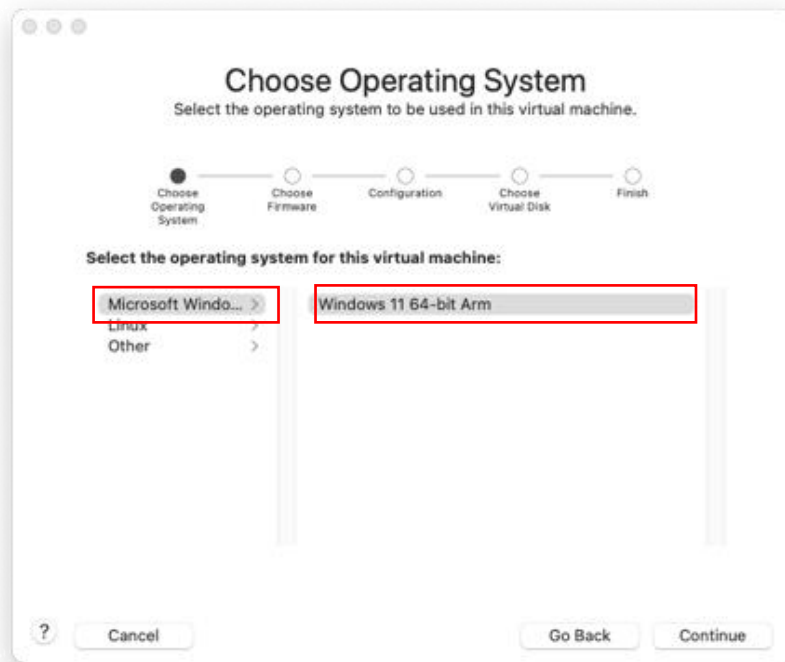
In both commands, *vhdx.VHDX* is the name of the downloaded file from Microsoft, and *Windows11.vmdk* is the name of the converted file. Please ensure that the converted file name contains the .vmdk extension.

3. Create a new virtual machine in Fusion using “**File > New...**” in the Fusion menu bar.
4. In the “**Select the Installation Method**” dialog, click “**Create a custom virtual machine**”

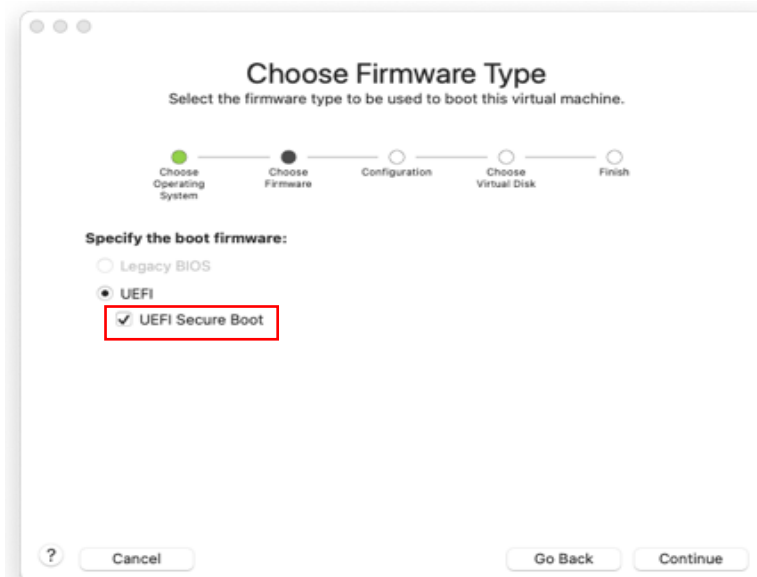


Click “**Continue**”.

5. In the “**Choose Operating System**” dialog, select “**Microsoft Windows**” in the left hand pane, and “**Windows 11 64-bit Arm**” in the right hand pane then click “**Continue**”.



6. In the “**Choose Firmware Type**” dialog, check the “**UEFI Secure Boot**” box, then click “**Continue**”.



7. The “**Choose Encryption**” dialog will now appear.



Select “**Only the files needed to support a TPM are encrypted**”.

Enter a password for the VM either by creating one yourself or by clicking the “**Auto Generate Password**” button.

Tip: Create the password yourself and record it in your favorite password manager even if you opt to have it remembered in the Keychain.

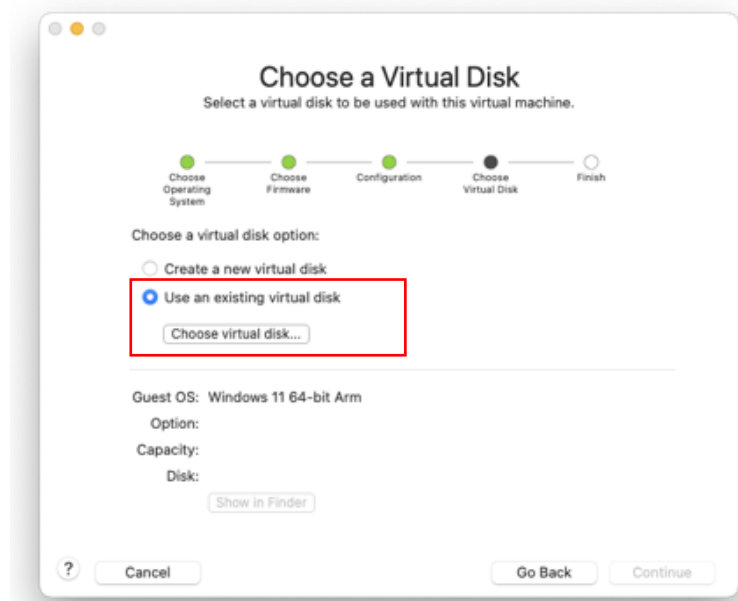
Optionally, select “**Remember Password and store it in Mac’s Keychain**”. This option will allow Fusion to automatically unlock a virtual machine for you when necessary (you don’t have to type in the password). You can also find the password in the user’s login Keychain with the macOS Keychain Access app.

Tip: Storing the password in the Keychain is no substitute for you knowing the VM’s password. You should anticipate the need to know the password to transfer an encrypted virtual machine to another machine/user, or to recover from an issue with the Keychain.

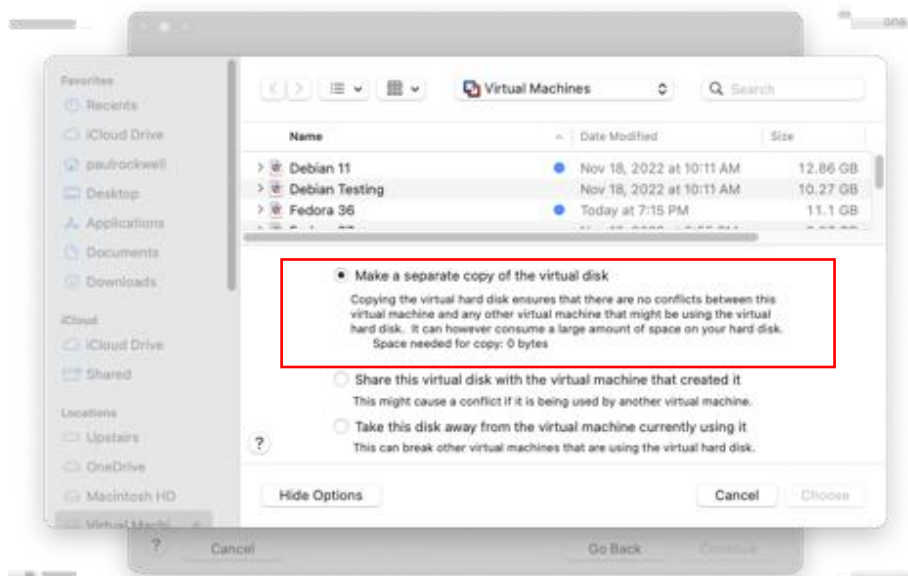
The Trusted Platform Module (TPM) device required by Windows 11 will be automatically added to the virtual machine configuration at this point.

Click “**Continue**”.

8. In the “Choose a Virtual Disk” dialog, select “Use an existing Virtual Disk”, then click the “Choose virtual disk....” button.



9. In the next dialog box, find and select the converted VMDK file.

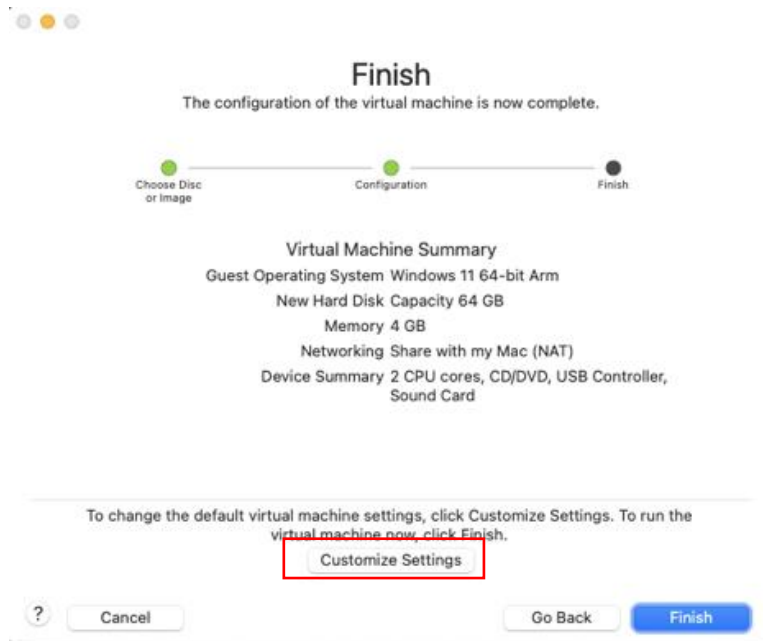


After finding the converted .vmdk file, select “**Make a separate copy of the virtual disk**”. This will copy the converted virtual disk into the new Windows 11 virtual machine and leaves the original copy of the converted virtual disk intact for future use.

Click “**Choose**” when finished. This dialog will close and return you to the “**Choose a Virtual Disk**” dialog.

Click “Continue” on the “Choose a Virtual Disk” dialog.

10. At the “**Finish**” screen, click the “**Customize Settings**” button rather than “**Finish**”. This will allow you to alter settings of your virtual machine before starting the installation.



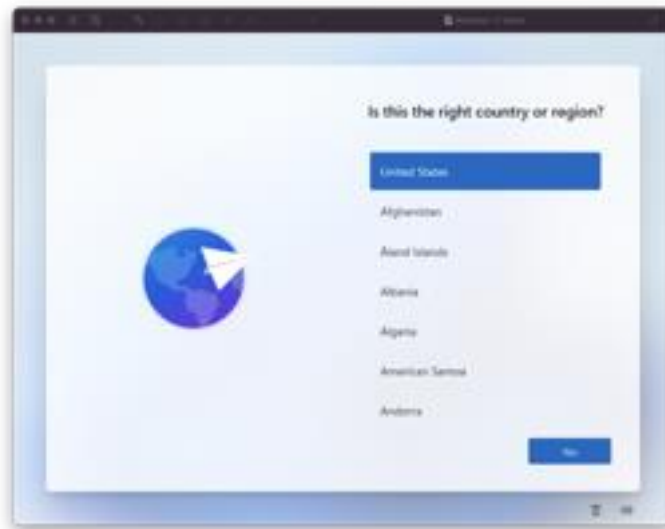
After clicking “**Customize Settings**”, name your VM and select the folder where the VM is to be stored.

11. The virtual machine’s “**Settings**” panel will appear. Make any changes to the number of processors, memory, and virtual hard disk size that are desired.

Note that the minimum hardware requirements for Windows 11 are 2 CPUs, 4 GB memory and a 64GB hard drive. It will fail to install if these minimums are not met.

12. Power on the virtual machine.

13. The first screen of the Windows 11 setup process appears:



Do not click on the “Yes” button.

13. VMware Tools need to be installed at this point so that Windows Setup can discover the network and complete its tasks.

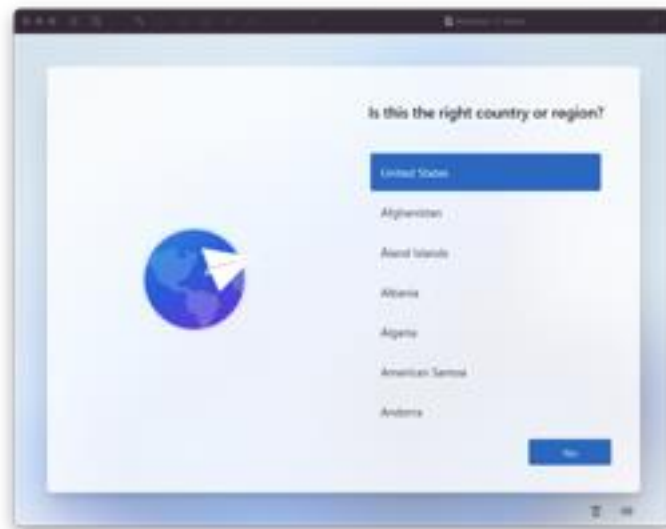
Follow the procedure in the topic [Installing VMware Tools on Windows 11 ARM](#) to install VMware Tools.

Autoplay is not enabled at this point in the Windows setup process. You will need to open a command prompt with **Shift-Fn-F10** and manually execute the VMware Tools `D:\setup.exe` to install VMware Tools.

Once you start the VMware Tools Setup, you may need to move windows or use **Option-Tab** to find the Tools Setup wizard.

When prompted, restart the VM at the completion of the Tools setup process.

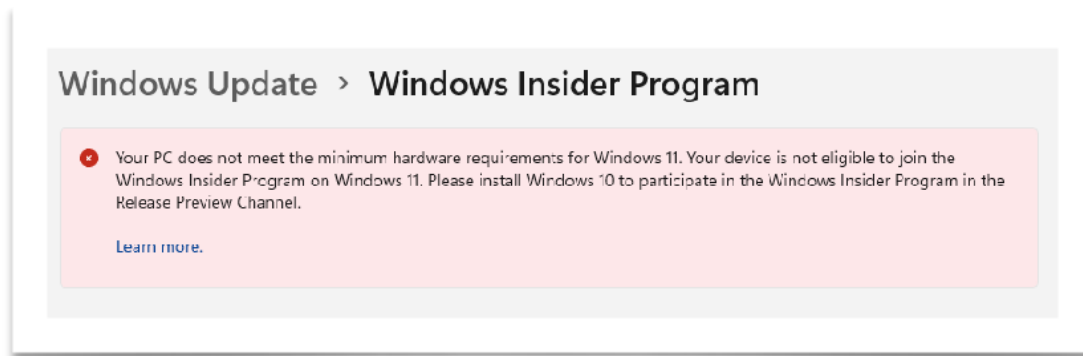
14. You will be returned to the first screen of the Windows 11 setup process after the VM restarts:



Continue with Windows setup. Setup will discover the network, and VMware Tools are already installed.

15.9 Windows 11 ARM VMs can't be enrolled in Windows Insider

If an attempt is made to enroll a Fusion Windows 11 ARM virtual machine in the Microsoft Windows Insider program via **Settings > Windows Update > Windows Insider Program**, the following message will be displayed:



Technically this is correct behavior. Microsoft does not consider Fusion on Apple Silicon CPUs to be a certified solution for Windows 11 ARM. The registration for the Windows Insider Program appears to be checking the CPU identification present in the Fusion VM and does not recognize it as a valid supported platform.

Do not try to install Windows 10 as the notice recommends. Windows 10 is not supported by Fusion on Apple Silicon.

The Windows 11 ARM Insider Preview Beta Channel release can be installed using the procedures found in the topic [Installing from Windows Insider VHDX files](#). Other Windows Insider Preview channels may be able to be installed using ISO media built from uupdump.net on a Windows system. Procedures for building these ISOs from uupdump.net are outside the scope of the Companion Guide.

Given Microsoft's recent change to certify Parallels on Apple Silicon for Windows 11 ARM and VMware's statements that they will be working toward the same goal, we hope that this restriction will go away in the future.

15.10 Microsoft Store app doesn't exist or crashes in a newly installed VM

Normally the Microsoft Store will be automatically installed for you by Windows 11 the first time that you open it. Occasionally though, the Microsoft Store app may not exist in a newly installed VM, or it may crash if you try to start it. If this happens, try this procedure to manually install the Microsoft Store app:

1. Open a Windows command prompt as administrator.
2. Execute the following command:

```
wsreset.exe -i
```

3. Wait for the Microsoft Store to install. This may take a while (longer than you might expect), so please be patient.

Up to 2 items may be installed:

- Store Experience Host
- Microsoft Store app

Windows will provide notifications as these components are installed.

When the procedure completes, the Microsoft Store should be installed and able to be opened.

15.11 Fusion folder sharing with the Mac host is not supported

The Folder Sharing option is not available for a Windows 11 ARM VM. Consider one of the following workarounds to share files between the Mac host and a Windows 11 ARM VM:

- Configure macOS Windows file sharing

Consult macOS Help (found in the Finder's Help menu bar) or Internet resources for instructions on how to configure macOS Windows file sharing, and then add the folders you wish to share with your VM to the configuration. This will allow the Windows VM to access the host via standard Windows file sharing.

This workaround should only be used when connected to a trusted network such as a home network. The use of macOS file sharing when connected to an untrusted network such as public or hotel Wi-Fi is a security risk. To mitigate this risk, disable file sharing in macOS when connected to an untrusted network.

- Drag and Drop

For simple file transfers between host and guest, consider dragging and dropping files between the Mac host and Windows 11 ARM guests. The speed of drag/drop has been noticeably increased over prior versions of Fusion (even on Intel) and may meet your needs if they don't include syncing folders with the host.

- Use a Remote Desktop client

If using Windows 11 Pro or Enterprise, you can access the VM with a Remote Desktop Protocol (RDP) client such as Microsoft Remote Desktop on the Mac and utilize its folder redirection capabilities. Consult Windows documentation on how to configure Windows for remote console access, and your RDP client documentation on how to enable folder redirection.

- Install Microsoft OneDrive, Dropbox, or a similar cloud file sharing client in both the VM and the Mac

Using cloud file sharing services in a VM allows content to be shared to Macs and any other platform that supports the service.

- Use a network file transfer utility such as WinSCP to transfer files between the Windows VM and the Mac host.

15.12 Enabling/disabling Secure Boot on Fusion Player

Both Fusion Pro and Fusion Player will allow you to configure a Windows 11 ARM VM for UEFI Secure Boot at the time the VM is created. After the VM is created, Fusion Pro will allow you to enable or disable Secure Boot through the Advanced panel of a VM's Settings. Unfortunately, Fusion Player doesn't.

If you are running Fusion Player and need to change the Secure Boot state, follow one of the following two procedures depending on the choice of encryption for the VM.

Option 1: VM is encrypted with “Only the files needed to support a TPM

1. Shut down the VM and close any open Settings windows for the VM. Do not shut down the Fusion GUI.
2. Right-click the VM’s name in the Virtual Machine Library, and then press the **Option** key. Then select “**Open Config File in Editor**”

The contents of the config file (.vmx file) will be opened in the Mac’s TextEdit app.

3. Search for a line in the file starting with:

```
uefi.secureBoot.enabled =
```

If it doesn’t exist, add the following line to the file (type it in exactly as shown, and the spaces around the “=” sign are required)

```
uefi.secureBoot.enabled = "FALSE"
```

4. To enable Secure Boot, change the line to read:

```
uefi.secureBoot.enabled = "TRUE"
```

To disable Secure Boot, change the line to read:

```
uefi.secureBoot.enabled = "FALSE"
```

5. Save the file and exit the TextEdit app.

You may now restart your VM.

Option 2: VM is encrypted with “All the files”

Read this carefully before using this procedure

This procedure will decrypt then re-encrypt your VM. Before doing anything,

- shut down (do not suspend) the virtual machine
- shut down Fusion
- make a backup copy of the entire VM bundle to another disk.

Make sure you have sufficient disk space to hold a complete copy of the VM's virtual disk during the decryption and re-encryption processes

This procedure deletes the TPM for the VM. In the rare circumstance that you enabled Bitlocker in the Windows 11 VM, **you must have the Bitlocker recovery key to regain access to your VM.** See the following Microsoft articles for information on backing up and finding your Bitlocker recovery key:

<https://support.microsoft.com/en-us/windows/back-up-your-bitlocker-recovery-key-e63607b4-77fb-4ad3-8022-d6dc428fbd0d>

<https://support.microsoft.com/en-us/windows/where-to-look-for-your-bitlocker-recovery-key-fd2b3501-a4b9-61e9-f5e6-2a545ad77b3e>

1. After making sure you have a backup of the VM, start VMware Fusion. Make sure the VM is shut down (not suspended) and remove all snapshots for the VM.
2. Open the VM's Settings.
3. Click on “**Trusted Platform Module**” and then click the “**Remove Trusted Platform Module**” button that appears. Confirm that you want the device removed.
4. Click the “**Show All**” button at the top of the window, then click on “**Encryption**”.

In the panel that appears, the current encryption state of the VM should be displayed. Select “**The virtual machine is not encrypted**” to remove the VM’s encryption.

Enter the password for the virtual machine if requested.

5. Be patient and wait for the virtual machine's encryption to be removed.
6. Close the VM's settings.
7. Right-click the VM’s name in the Virtual Machine Library, then press the **Option** key. Then select “**Open Config File in Editor**”

The contents of the config file (.vmx file) will be opened in the Mac’s TextEdit app.

8. Search for a line in the file starting with:

```
uefi.secureBoot.enabled =
```

If it doesn't exist, add the following line to the file (type it in exactly as shown, and the spaces around the "=" sign are required.):

```
uefi.secureBoot.enabled = "FALSE"
```

9. To enable Secure Boot, change the line to read:

```
uefi.secureBoot.enabled = "TRUE"
```

To disable Secure Boot, change the line to read:

```
uefi.secureBoot.enabled = "FALSE"
```

10. Save the file and exit the TextEdit app.
11. Open the VM's Settings.
12. Re-encrypt the VM. Click on **"Encryption"** and select the desired type of encryption to apply to the VM. It is recommended to choose **"Only the files needed to support a TPM"**.

Choose a password (and remember it) and optionally opt to save it in the Mac's Keychain.
13. Wait for the VM to re-encrypt itself (if you chose **"All the files"** it will take a while, so be patient).
14. Click the **"Show All"** button to return to the main Settings page.
15. Click the **"Add Device"** button in the upper right-hand corner. A list of devices will appear.
16. Click on **"Trusted Platform Module"**, then click **"Add"**.
17. Close the VM's Settings.

You may now restart your VM.

If you had Bitlocker enabled, you will need to perform Bitlocker recovery per Microsoft's instructions.

You may be required to re-verify your login credentials the first time that you log into the VM. This is likely to happen if you've configured your login to use a Microsoft account and you're using Windows Hello with a PIN instead of specifying a password.

Verifying Secure Boot settings in a Windows 11 VM

See the following Microsoft article for how to check the status of Secure Boot in your virtual machine: <https://learn.microsoft.com/en-us/mem/intune/user-help/you-need-to-enable-secure-boot-windows>

15.13 WSL2/Hyper-V/etc do not work in a Windows 11 ARM VM

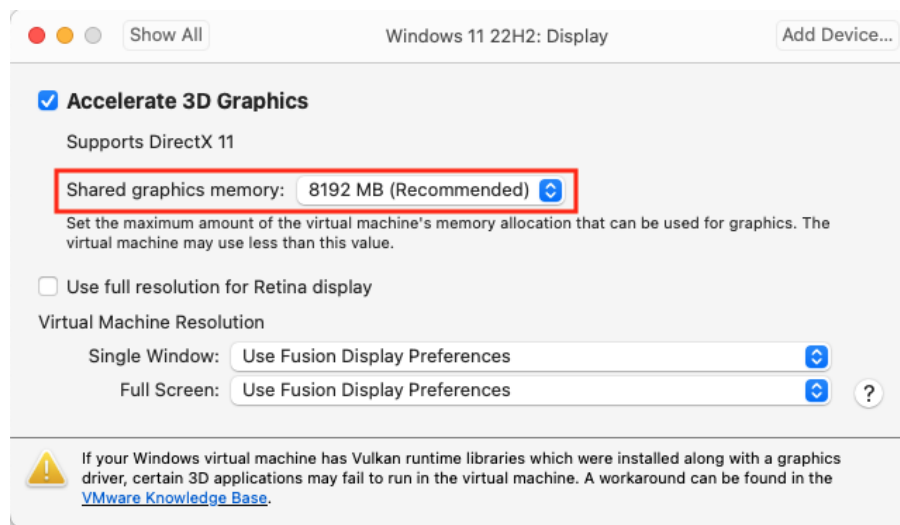
WSL2, Hyper-V, and other Microsoft technologies that use virtualization functions cannot work in a Windows 11 ARM VM. This is because the Apple's Hypervisor Framework that Fusion must use does not support nested virtualization.

WSL1, which does not use Hyper-V features, will work in a Windows 11 ARM VM.

15.14 Screen flickering / screen goes black after upgrading VM

Thanks to @joedec for this tip.

After upgrading a Windows 11 VM to Fusion 13.5 (upgrade of virtual hardware version and installation of the latest VMware Tools), the console window may go blank or go black every few seconds. If this happens to you, shut down the VM and open **Settings > Display** for the VM. Make sure that “**Shared graphics memory**” is set to recommended value of 8192.



15.15 Updated VMware Tools are available for Windows 11 ARM

Thanks to @gringley for the heads-up.

On 2023-10-26 VMware updated VMware Tools to version 12.3.5 to resolve 2 security issues. These updated tools are available for Windows 11 ARM.

- Download link for VMware Tools 12.3.5 (contains downloads for all supported platforms): https://customerconnect.vmware.com/en/downloads/details?downloadGroup=VMTOOL_S1235&productId=1259&rPIId=112353
- Release notes for VMware Tools 12.3.5: <https://docs.vmware.com/en/VMware-Tools/12.3/rn/vmware-tools-1235-release-notes/index.html>

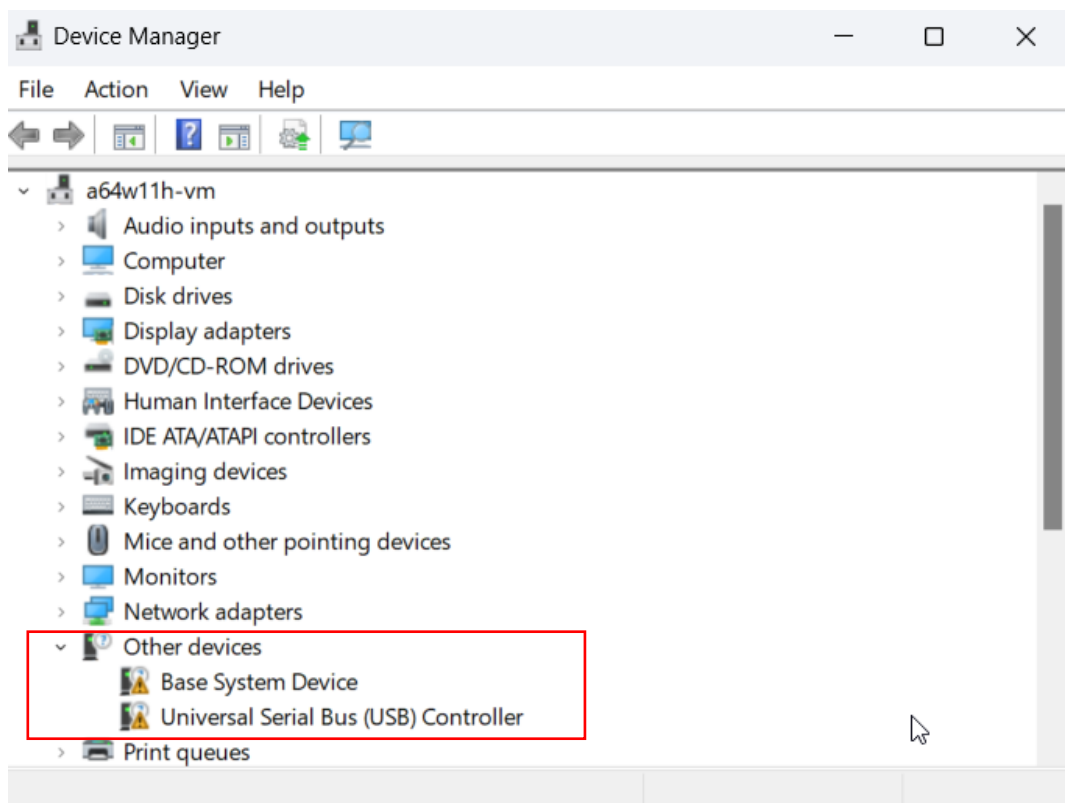
Tip: If you have already installed VMware Tools in your Windows 11 ARM VM, upgrade the tools using the “**VMware Tools for Windows Arm, in-guest installer**” rather than the “**VMware Tools packages for Windows Arm**” zip or gz downloads.

Download the in-guest installer directly into the VM, unzip it, and run the extracted .exe file to upgrade the tools.

15.16 Windows Device Manager shows no driver for two devices

Thanks to @coolryg for the explanation of why this happens.

Windows 11 ARM users will find that two devices in the Device Manager are present but have no device driver:



The lack of a driver for these two devices can be ignored. They will not impact operation of the VM.

The gory details about these devices that don't have drivers

The Base System Device is the VMCI Bus device. This device is used in VMware products to support host-to-guest application level communication (Vsockets). If you're interested in more details on what Vsockets are, see https://vdc-download.vmware.com/vmwb-repository/dcr-public/a49be05e-fa6d-4da1-9186-922fbfef149e/a65f3c51-aaeb-476d-80c3-827b805c2f9e/ws9_esx60_vmci_sockets.pdf.

VMware currently does not provide a driver for the VMCI Bus device on Windows 11 ARM like it does for Windows on Intel. It is reportedly planned for a future release. The missing driver for this device does not impact the operation of the virtual machine other than not supporting Vsocket functionality.

The Universal Serial Bus (USB) Controller is a UHCI USB virtual device that Fusion presents to the virtual machine by default. Neither VMware nor Microsoft provide a driver for this device for Windows 11 ARM.

The missing USB device driver is not an issue because Fusion presents a second USB device to the virtual machine. This device will be claimed by Microsoft's Standard USB 3.2 eXtensible Host Controller (XHCI) driver. USB devices that are connected to the guest by Fusion will be connected to the XHCI controller, not the UHCI controller.

If you don't like the clutter of having a device without a driver, the UHCI USB virtual device can be disabled by editing the VM's configuration file and adding the following line:

```
usb.uhci.present = "FALSE"
```

Appendix A. Glossary

Apple Silicon	<p>Apple’s term for its in-house developed SoC (system on a chip) CPUs based on the ARM architecture. Apple Silicon chips are used in Macs, iPhones, iPads, Apple TV, and Apple Watch.</p> <p>The M1 and M2 CPU chips are Apple Silicon CPUs.</p>
ARM	<p>The RISC CPU architecture used by Apple as the basis for its Apple Silicon CPUs. It is different from and incompatible with Intel/AMD CPU architectures.</p> <p>Also refers to the company (Arm Ltd.) that develops the ARM CPU architectures and licenses them to vendors such as Apple or Qualcomm that produce ARM CPU chips.</p>
arm64/aarch64	<p>Refers to the 64-bit ARM CPU architecture or instruction set. Incompatible with x86 or x64/x86_64 architectures.</p>
Blacklisting a driver	<p>The process of preventing the Linux kernel from using a specific device driver module that has been included with the kernel. It is most often used to disable the use of a graphics adapter driver that is not working correctly, and forces the use of an alternate, generic graphics device driver.</p> <p>This document prefers the term “disabling the use of a driver”, even though the mechanisms used to accomplish the task still use the term “blacklist”.</p>
Bridged networking	<p>A virtual network configuration that connects the virtual machine network directly to a network that the host is using. There is no isolation of the virtual machine from network traffic.</p> <p>The IP address for a VM configured for a bridged network will be a unique address on the same network as the host.</p> <p>Compare with 'NAT networking'.</p>
EOL	<p>Shorthand for End of Life. The phase in a software’s lifecycle where the developer stops development of a version of its software and is no longer providing support for it. This usually means that the developer is no longer providing updates or security patches for the software.</p>

Emulation	<p>The ability to simulate a different architecture and instruction set on the current hardware. An example is QEMU - software that emulates an Intel CPU on Apple Silicon hardware and allows Intel based operating system to run. Typically runs emulated CPU instructions more slowly than native instructions.</p> <p>Compare with 'Virtualization'.</p>
ESXi	<p>VMware's enterprise-class hypervisor software that runs on Intel or AMD computers. It is part of the vSphere product line. A free version with restricted functionality is available.</p>
EULA	<p>Shorthand for End User License Agreement. EULAs are a legal contract between a software provider and customer. They specify the rights and restrictions that apply to the use of the software by the customer.</p>
GA	<p>Shorthand for "Generally Available". GA software versions are publicly released by the developer to all users and typically receive full support from the developer.</p> <p>This contrasts with pre-release versions such as beta, preview, or development versions which may not be publicly available to all users and may not receive the same support from the developer (or any support at all) that GA versions do.</p>
GRUB	<p>Software that manages the early stages of the boot process for a Linux operating system. It is the de-facto standard system bootstrap utility for almost all Linux operating system distributions.</p> <p>GRUB is shorthand for 'GRand Unified Bootloader' in case you were wondering.</p>
Guest	<p>A virtual machine that runs under the control of a hypervisor.</p> <p>Compare with 'Host'.</p>
Host	<p>An operating system that runs a hypervisor that permits the use of virtual machines. Example: A Mac that is running VMware Fusion is considered the host.</p> <p>Compare with 'Guest'.</p>
Hypervisor	<p>From Wikipedia: https://en.wikipedia.org/wiki/Hypervisor</p> <p>A hypervisor is a type of computer software, firmware or hardware that creates and runs virtual machines. The hypervisor presents the guest operating systems with a virtual operating platform and manages the execution of the guest operating systems. Unlike an emulator, the guest executes most instructions on the native hardware.</p>

ISO	<p>Colloquial term for an industry-standard, cross-platform disk image format that is typically used for the distribution and installation of software such as operating systems.</p> <p>The term is derived from the ISO 9660 international standard that describes the format of the disk image.</p>
KB article	Shorthand for “Knowledge Base” article or tech note.
Kernel	<p>From Wikipedia: https://en.wikipedia.org/wiki/Kernel_(operating_system):</p> <p>The kernel is a computer program at the core of a computer's operating system and generally has complete control over everything in the system. It is the portion of the operating system code that is always resident in memory and facilitates interactions between hardware and software components.</p> <p>The term ‘kernel’ is typically used in Linux environments to refer to the memory resident portion of the Linux operating system that is loaded into the computer’s memory by the boot loader.</p>
M1, M2, and M3	Apple Silicon CPU chips used by Apple in Macs beginning in late 2020.
NAT networking	<p>A virtual network adapter configuration that creates a unique localized network that’s isolated from the host’s network. This is like what you would find on a home wireless router to isolate you from a broadband provider’s network.</p> <p>The IP address for a VM connected to a bridged network will be on a different network than the host. A NAT firewall implemented by Fusion routes network traffic from virtual machines running within the NAT network to the host’s configured network.</p> <p>Also known as ‘Shared with my Mac’ in the Fusion virtual machine network adapter configuration.</p> <p>Compare to ‘Bridged networking’</p>
Nested virtualization	<p>The ability to run a hypervisor application in a virtual machine, which in turn allows virtual machines to run using that hypervisor inside the virtual machine.</p> <p>Thinking of the film ‘Inception’ may help you understand this concept. Or the “gangster movie within a movie” from ‘Home Alone’.</p>

open-vm-tools	<p>Open source versions of VMware’s in-guest hypervisor tools for Linux and other UNIX-like operating systems. open-vm-tools are created and maintained by VMware and donated to the open source community.</p> <p>Open-vm-tools packages are available in most Linux distributions (including arm64 versions) through their repositories. They are the preferred tools for Linux guests running under VMware products.</p> <p>See ‘VMware Tools’.</p>
.ova/.ovf	<p>A vendor-neutral virtual machine interchange format. Allows a virtual machine to be more easily transported from one virtualization product to another while retaining important settings and configuration.</p>
Repository/Repo	<p>A storage location for software packages maintained by an operating system’s vendor. Package managers in Linux distributions typically use on-line repositories to install and/or update software on systems.</p> <p>Credit: Wikipedia https://en.wikipedia.org/wiki/Software_repository</p>
Virtualization	<p>The ability to share hardware resources of a computer to run additional operating system environments of the same CPU architecture. Typically runs most CPU instructions at native CPU speed.</p> <p>See ‘Hypervisor’.</p> <p>Compare with ‘Emulation’.</p>
VM	<p>Shorthand for virtual machine or guest.</p>
VHDX file	<p>The file format used by Microsoft Hyper-V for its virtual disk files. Can be converted for use under Fusion.</p> <p>Compare with ‘VMDK file’.</p>
VMDK file	<p>The file format used by VMware Fusion for its virtual disk files.</p> <p>Compare with ‘VHDX file’.</p>
VMware SVGA 3D	<p>The graphics adapter that is presented to virtual machines by Fusion (and other VMware hypervisors).</p> <p>Virtual machines do not have direct access to a host’s graphics card. The VMware SVGA 3D adapter provides a graphics display to the virtual machine that can be shared with the host’s graphics adapter.</p>

VMware Tools	<p>Proprietary versions of VMware’s in-guest hypervisor integration tools provided directly by VMware for Windows and older x86/x64 Linux distributions that do not support open-vm-tools.</p> <p>See ‘open-vm-tools’.</p>
vmwgfx	<p>The Linux kernel device driver that provides support for the VMware SVGA 3D virtual graphics adapter.</p> <p>See ‘VMWare SVGA 3D’</p>
Windows 11 ARM	<p>The version of Windows 11 produced by Microsoft to run on ARM architecture PCs. It is the Windows version that is used in Microsoft Surface devices with Microsoft SQ CPU chips and OEM devices that use Qualcomm Snapdragon CPUs such as those from Lenovo, HP, Acer, and Samsung</p>
x64/x86_64	<p>Refers to the 64-bit Intel/AMD CPU architecture or instruction set. Incompatible with arm64/aarch64 architectures.</p>
x86	<p>Refers to the 32-bit Intel/AMD CPU architecture or instruction set. Incompatible with arm64/aarch64 architectures.</p>

Appendix B. Archived Topics

The topics in this section discuss issues that were reported in older versions of Linux operating systems. In almost all cases, these issues have been fixed in current Linux operating system releases.

B.1. FIXED: RHEL 9.0 installation ISOs will not boot

This issue is fixed in RHEL 9.1 and later.

B.2. FIXED: Blank screen when text mode installation is selected

This issue was seen with RHEL 9.0 and older CentOS 9 Stream ISO installation media. Use RHEL 9.1 or later or current releases of CentOS 9 Stream where this issue is fixed.

B.3. FIXED: Unable to change graphics resolution in a RHEL 9.0 VM

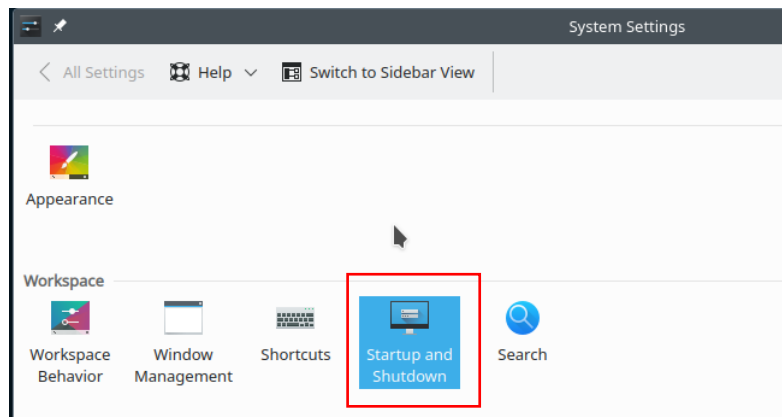
This issue is fixed in RHEL 9.1 and later. Use those installers instead of RHEL 9.0.

B.4. FIXED: Unable to change screen resolution in a KDE Plasma session

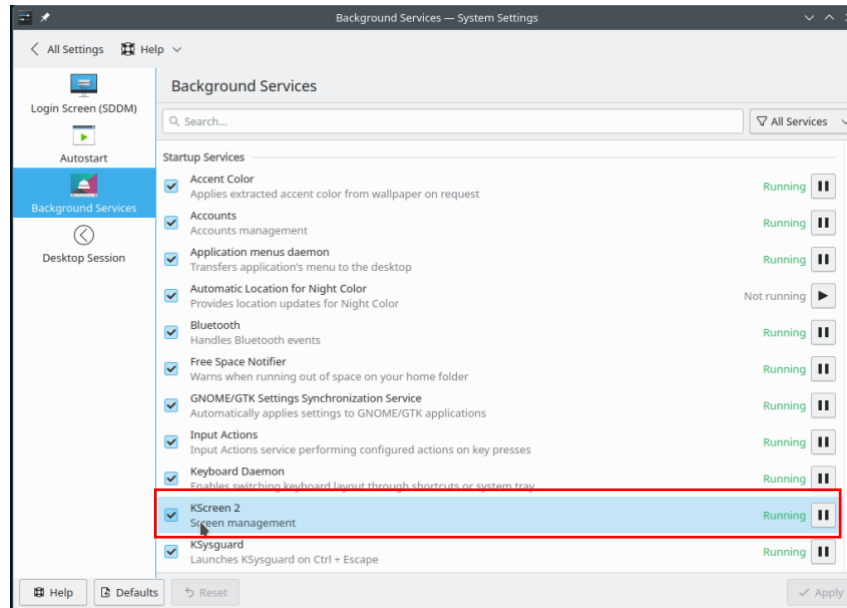
There is a bug in KDE Plasma releases prior to 5.24.2 that causes any attempt to change screen resolution in the virtual machine to switch briefly to the new value, then switch back immediately to the defaults. The issue is fixed in later KDE Plasma releases starting with 5.24.2.

Use the following procedure to work around this issue in KDE Plasma releases prior to 5.24.2:

1. In the guest OS, open the System Settings app.
2. Under the “Workspace” category, click on the “Startup and Shutdown” icon.



3. Click on the “Background Services” icon, then scroll down the list of “Background Services” until you see “KScreen 2” under the “Startup Services” category.



4. Uncheck "KScreen 2" to disable it from automatically running. If KScreen2 is already running, stop it using the pause button on the right.

Click the “**Apply**” button in the lower right hand corner.

5. Log out and log back in again.

The screen resolution can now be changed using the appropriate KDE Plasma control panels.

Note that when using the workaround, the updated resolution will not persist across login sessions. The resolution must be reset to the desired values after session logout or reboot. This issue is also fixed in KDE Plasma 5.24.2 and later.

B.5. Leap 15.4 installer hangs at “Starting udev”

(thanks to @mvreijn for reporting this)

When installing from Leap 15.4 ISO media, the guest may hang at “Starting udev”.

To work around this, disable the vmwgfx driver as follows:

1. Boot the ISO installation media
2. Select “Installation”, but do not press return. Instead, press ‘e’ to edit the GRUB command line.
3. Add the following to the kernel boot arguments (the line starting with “linux /boot/aarch”):

```
modprobe.blacklist=vmwgfx
```

4. Press **Control-x** to boot the installer.

Note that the disabling of `vmwgfx` will persist into the installed VM. The installer writes the kernel boot argument into the GRUB boot commands where it will be used on all future boots.

After installation and application of software updates, the installed VM will have a newer kernel that supports the use of the `vmwgfx` driver. Once the newer kernel is installed, use the Boot Loader module of YaST to remove the kernel boot argument added in step 3 above and reboot the VM.