

# **The *Unofficial* Fusion 13 for Apple Silicon Companion Guide**

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

Revision 17 (19-May-2023)  
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# 1. Introduction

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The Unofficial Fusion 13 for Apple Silicon Companion Guide (the “Companion Guide”) is an unofficial addition to the VMware Fusion 13 documentation. It contains a collection of useful tips and techniques for building and running virtual machines under Fusion 13 on Apple Silicon (M1/M2) Macs. These tips were submitted by users on the VMware Fusion Discussions and 22H2 Tech Preview 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 only covers Fusion 13 on Apple Silicon Macs

The editorial decision was made to focus the Companion Guide on the Apple Silicon platform because of the newness of arm64 operating systems and the drastic changes to the expectations of Mac users introduced by Apple’s decision to switch from Intel CPUs. Users are more likely to encounter the issues and “peculiarities” described in the Companion Guide on Fusion 13 on M1/M2 Macs. The issues in the Companion Guide are unlikely to be observed by users of Fusion on Intel Macs.

## 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 sysadmin 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. Knowledge is good.

## 1.4. Document conventions

Commands to be entered into a terminal prompt will be preceded by the appropriate shell prompt. If you copy/paste the command, do not include the shell prompt character(s).

Commands to be executed with normal user privileges on Linux/macOS will appear as follows:

```
$ command arg1 arg2
```

Commands to be executed with elevated privileges (sudo to root) will appear as follows:

```
# command arg1 arg2
```

Commands to be executed in the Windows command line app will appear as follows:

```
C:> command arg1 arg2
```

Commands to be executed in Windows Powershell will appear as follows:

```
PS> command arg1 arg2
```

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 made 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.
- @k\_ronny – For inspiration on how to modify RHEL 9 configurations to increase the default graphics resolution until Red Hat fixes it.
- @palter – for independently confirming how to get CentOS 9 Stream working on the Tech Preview, and 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

- Burke Azbill (Twitter: @TechnicalValues) – for discovering issues with Fedora 36 updates.
- @bogdan - For providing information on how to obtain ESD distributions from Microsoft (<https://gist.github.com/b0gdanw/e36ea84828dbd19e03eff6158f1fc77c>). This information was used in the creation of the tool that creates an ISO from ESD.
- @santhonysasse - for providing a most excellent video walkthrough for installing Windows 11 ARM on Fusion using the instructions found in the Companion Guide.
- @gsmgmt - for reporting that Ubuntu Desktop 22.04 daily builds are broken.
- @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.
- @AFerrit (Dan Mahoney – for reporting issues with the installation of the iCloud app on Windows 11 ARM and for providing a solution.

## 2. General Notes

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### 2.1. Review the Fusion documentation

VMware does provide online and PDF documentation for Fusion 13. It should be your first point of reference when you have questions about how to do something with Fusion.

Fusion documentation can be found:

- Within Fusion itself. From the Fusion menu bar, select Help > VMware Fusion Help
- Using a web browser to navigate to: <https://docs.vmware.com/en/VMware-Fusion/13/com.vmware.fusion.using.doc/GUID-F2874B79-A32A-4B83-914F-9838372D47CD.html>
- In a PDF document that can be downloaded from <https://docs.vmware.com/en/VMware-Fusion/13/fusion-13-user-guide.pdf>

### 2.2. Review VMware KB article 90364

VMware has published the 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 the officially supported ARM guest operating systems, and
- Operating systems that are NOT supported by Fusion 13 on Apple Silicon. 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 13 documentations. It should be considered mandatory reading before attempting to create any virtual machine on Apple Silicon Macs.



## 2.3. Unsupported features of Fusion 13 on Apple Silicon

The Fusion 13 release notes and documentation do not clearly describe where Fusion 13 on Apple Silicon Macs differs from Fusion 13 on Intel Macs. In some cases, you must closely read release notices and the VMware Fusion documentation, and in others it's not clear at all.

Fusion 13 on Apple Silicon Macs does not implement:

<ul style="list-style-type: none"><li>• Running of any virtual machine requiring Intel x86 or x64 CPUs</li><li>• Virtualization of any version of macOS</li><li>• Importing or exporting a virtual machine using .ova or .ovf formatted files</li><li>• Conversion of virtual machines from Parallels</li><li>• Virtual Printer (ThinPrint) sharing with the host Mac (workaround available)</li><li>• Nested virtualization</li><li>• Copy/Paste/Drag/Drop for Windows 11 ARM guests</li></ul>	<ul style="list-style-type: none"><li>• Fusion shared folders for Windows 11 ARM guests (workaround available)</li><li>• “Soft” power options for Windows 11 ARM guests</li><li>• Synchronizing time between host and guest for Windows 11 ARM guests.</li><li>• 3D accelerated graphics for Windows 11 ARM guests</li><li>• Changing the screen resolution of a Windows 11 ARM guest by resizing the guest's window (must change resolution from inside guest)</li><li>• Unity for Windows 11 ARM</li><li>• Multiple monitor support</li></ul>
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If you need any of these features, consider staying on an Intel Mac where these features are still supported by Fusion 13.

## 2.4. Arm64 operating systems known to work on Fusion 13

If you're starting out with Fusion 13 on Apple Silicon, here's a few suggestions for arm64 operating systems. This list includes distributions that are officially supported by VMware as well as those that are known to work.

This is not a comprehensive list.

<ul style="list-style-type: none"><li>• AlmaLinux 9.1</li><li>• CentOS 9 Stream</li><li>• Fedora 36, 37, 38, Rawhide</li><li>• Debian 11.4, 11.5, 11.6, bookworm</li><li>• Kali Linux 2022.3 and later</li><li>• OpenSUSE Leap 15.4, 15.5 beta</li></ul>	<ul style="list-style-type: none"><li>• OpenSUSE Tumbleweed</li><li>• Oracle Linux 8.7, 9.1</li><li>• Red Hat Enterprise Linux 9.1</li><li>• Rocky Linux 9.1</li><li>• Ubuntu 20.04.5, 22.04.2, 23.04</li><li>• Windows 11 ARM 22H2</li></ul>
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Please see other sections within this guide for details on any observed issues with these releases.

Later versions of the above distributions will generally work. Older versions **in all likelihood will not work**. See the rest of the Guide for more detailed discussions on releases that work well and ones that don't.

VMware has implemented a “standard” virtual hardware environment that is certified to ARM System Ready specifications. This means other arm64 Linux distributions with reasonably current kernels (5.19 and later) and packages will likely work with Fusion 13. You are encouraged to try them and report your experiences back to the broader Fusion community.

## 2.5. Linux 3D graphics acceleration

Fusion 13 supports OpenGL 4.3 for 3D accelerated graphics on arm64 Linux virtual machines through the Mesa 3D libraries. Fusion 13 does not currently support Vulkan.

The Fusion 13 documentation and the Display settings do not clearly specify the requirements for 3D acceleration on arm64 Linux. They simply state “Linux kernel and Mesa 3D versions that support 3D accelerated graphics are required”.

3D acceleration for an arm64 Linux VM on Fusion 13 requires:

- Virtual hardware version of 20. This is the default for new virtual machines with Fusion 13 on Apple Silicon.
- 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 will work on the following arm64 Linux distributions:

- Ubuntu 22.10 and 23.04
- Fedora 36 (with latest kernel updates), 37, 38 and Rawhide
- Debian bookworm/testing (development version of Debian 12)
- OpenSUSE Tumbleweed snapshot 20230403 and later
- Kali Linux 2023.1

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

- Ubuntu 22.04.2 and earlier
- 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.x
- 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.

## 2.6. Fusion 13 on Apple Silicon does not run Intel virtual machines

As stated in KB article <https://kb.vmware.com/s/article/90364>, operating systems built for Intel 32- or 64-bit processors will not run on Fusion 13 on Apple Silicon Macs.<sup>1</sup>

Parallels has the same behavior.

This issue impacts users that:

- have virtual machines created with Fusion running on Intel Macs,
- want to run older versions of Windows client or any version of Windows Server, and
- want to run older versions of macOS.

If you are one of these users, consider:

- Using an Intel CPU emulator such as QEMU or UTM. Be aware that the performance of emulated Intel CPUs on Apple Silicon may not be acceptable.
- Continuing to run virtual machines on an Intel Mac.
- Using an Intel/AMD PC to run Windows or Linux VMs with VMware Workstation<sup>2</sup>
- For the more technically inclined, using a computer with an Intel/AMD CPU to run Windows or Linux VMs with the free version of the VMware ESXi hypervisor<sup>3</sup>.

Some community members indicate that there is a developer preview of Oracle VirtualBox for Apple Silicon. The VirtualBox developers consider it to be highly experimental and potentially buggy with “modest performance”<sup>4</sup>. From what information is available it appears they have included a rudimentary Intel x86 (32-bit) emulator which will not run any 64-bit Intel operating systems. Community feedback on this VirtualBox release would be appreciated.

## 2.7. Some arm64 Linux installers do not boot on Fusion 13

Some older arm64/aarch64 installation ISOs may not boot on Fusion 13 on Apple Silicon Macs. They will display a blank screen with either no cursor or a static non-blinking cursor.

A common cause of this problem for distributions other than Ubuntu 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 13.

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<sup>1</sup> 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.

<sup>2</sup> 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.

<sup>3</sup> 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.

<sup>4</sup> Editor’s comment: I read this as a kind way of saying “poor performance”.

Ubuntu releases may also exhibit this failure to boot. Their difficulties are due to other issues their kernels have with Fusion 13. Please see the section on [Ubuntu](#) for more information.

For distributions other than Ubuntu, check 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 many cases these will allow the installer or virtual machine to boot using the default Linux frame buffer graphics driver.

Procedure: Disabling the VMware vmwgfx graphics driver in Linux	
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 <b>‘Enter’</b> . Instead, press <b>‘e’</b> . 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:  <code>modprobe.blacklist=vmwgfx</code>  For Debian-derived releases (including Kali Linux), add the following instead:  <code>module_blacklist=vmwgfx</code>
3.	Press <b>Ctrl-x</b> 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 vmwgfx driver may not be the problem and additional troubleshooting needs to be performed.

## 2.8. Use open-vm-tools with arm64 Linux

There is no Fusion GUI menu item to "Install VMware Tools" for arm64 Linux VMs. That's because VMware doesn't provide them.

open-vm-tools are the VMware-recommended in-guest tools for all Linux operating systems and are the only in-guest tools available for arm64 Linux VMs. Install both open-vm-tools and open-vm-tools-desktop packages from the Linux distribution's repositories - almost all arm64 Linux distributions provide them, and many install them for you automatically.

VMware does provide VMware Tools for Linux with VMware Fusion on Intel Macs, VMware Workstation, and ESXi. However, these tools are only available for use on older Intel Linux distributions that do not provide open-vm-tools.

## 2.9. 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.	<p>If you are installing Windows, you must use Windows 11 ARM ISO installation media. See the topic <a href="#">Obtaining Windows 11 ARM ISO installation media</a>.</p> <p>If you are installing Linux, download arm64/aarch64 ISO installation media for your distribution.</p>
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 and either click the mouse in the guest’s console window or type 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>

## 2.10. Unable to change the display resolution of a Linux virtual machine

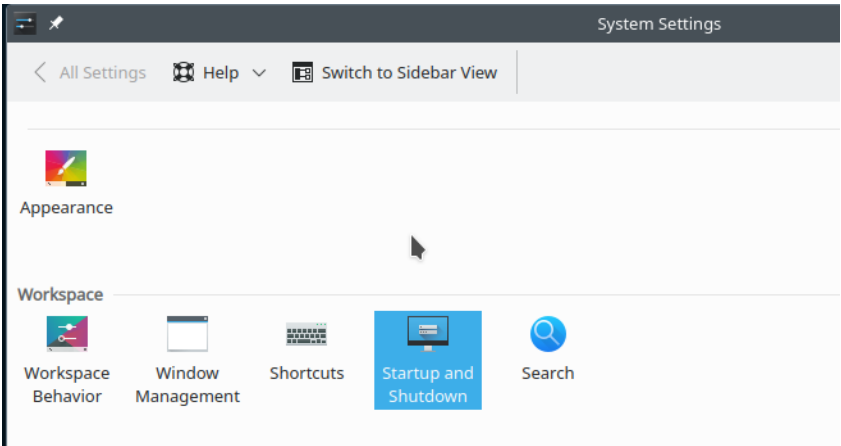
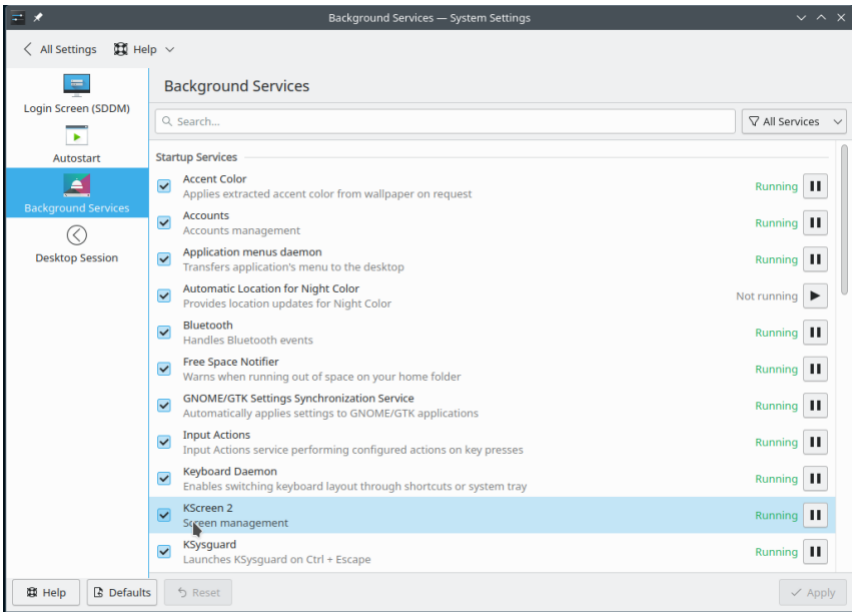
Changing the resolution of a Linux virtual machine display requires a Linux kernel that contains the VMware SVGA (vmwgfx) driver. VMware donated the vmwgfx driver to the Linux kernel maintainers, and it should be included out-of-the-box in most vendor distributions with a 5.14 kernel or later.

This issue will be seen most often in Debian 11 releases. The kernel that is released with these distributions is a 5.10 version which does not contain the VMware driver.

## 2.11. 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:

Procedure: Enable screen resolution change in KDE Plasma releases prior to 5.24.2	
1.	In the guest OS, open the System Settings app.
2.	<p>Under the “Workspace” category, click on the “Startup and Shutdown” icon.</p> 
3.	<p>Click on the “Background Services” icon, then scroll down the list of “Background Services” until you see “KScreen 2” under the “Startup Services” category.</p> 

Procedure: Enable screen resolution change in KDE Plasma releases prior to 5.24.2	
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.

## 2.12. Shared folders do not automatically mount in a Linux virtual machine

This issue is seen when the shared folder client is implemented using the FUSE user-space file system framework. open-vm-tools on arm64 Linux uses this type of shared folder client. See the following VMware KB article for more information: <https://kb.vmware.com/s/article/60262>.

The standard documented workaround 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.

Procedure: Mounting shared folders at boot of a Linux VM	
1.	Log into the VM and sudo to root.
2.	Verify the mount point directory <code>/mnt/hgfs</code> exists in the VM. If it doesn't, create the empty directory.
3.	Edit <code>/etc/fstab</code> . Add the following line to the file: <pre>vmhgfs-fuse /mnt/hgfs fuse defaults,allow_other,_netdev 0 0</pre>
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>.

## 2.13. 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>.

## 2.14. Printing from virtual machines on Linux and Windows

Fusion 13 on Apple Silicon does not implement Fusion virtual printing (ThinPrint) functionality that allows the virtual machine to automatically share the printers defined on the host Mac.

Workarounds include (these apply to both Linux and Windows guests):

- Guests using Bridged networking can connect directly to any reasonably modern network printer supported by AirPrint or Windows network printing. The printers are discovered and configured by the printer configuration utilities in the virtual machine.
- Guests using NAT networking can connect to any printer that has printer sharing enabled by the macOS host. Use the printer setup utilities provided by the guest operating system to configure these printers. This works for any printer regardless of whether it is directly connected or wirelessly connected to the Mac host.



## 3. CentOS Stream

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**Note:** This section discusses CentOS 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.

### 3.1. General notes

CentOS 9 Stream will install and run on Fusion 13.

- 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 or by resizing the console window.

Choose “Red Hat Enterprise Linux 9 64-bit Arm” as the operating system type when creating the virtual machine.

### 3.2. CentOS 8 Stream does not work

CentOS 8 Stream does not work on Fusion 13 on Apple Silicon. The kernels for ARM systems 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.

## 4. Debian

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### 4.1. General notes

Debian 11 “bullseye” 11.4, 11.5 and 11.6 work on Fusion 13.

- 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](#) should you want to resize the VM’s console resolution.
- 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 “bookworm/testing” (the development version of the next Debian release) also works on Fusion 13.

- Console resolution change is supported.
- 3D acceleration works.
- Open-vm-tools and open-vm-tools-desktop are available in the “bookworm” repos.

### 4.2. Obtaining newer kernel versions for Debian 11

The Debian 11 arm64 releases ship with a 5.10 version of the Linux kernel. While this kernel works with Fusion 13, it does not contain the 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:

Procedure: Short version of installing a bullseye-backports kernel	
1.	Open your terminal application and sudo to root.
2.	Add the following line to /etc/apt/sources.list: <code>deb http://deb.debian.org/debian bullseye-backports main contrib non-free</code>
3.	Run the following command to update the available package information: <code># apt update</code>
4.	Run the following command to list kernels available for installation. <code># apt list 'linux-image*'</code> Anything with "bullseye-backports" attached to the name is available from the backports repo.

#### Procedure: Short version of installing a bullseye-backports kernel

- |    |   |
|----|---|
| 5. | <p>Install a 5.18 or later kernel from the bullseye-backports repo. Example:</p> <pre># apt install linux-image-5.19.0-0.deb11.2-arm64/bullseye-backports</pre> <p>Note: be sure to specify the exact name of the package. A command such as</p> <pre># apt install linux-image-5.19.0-0.deb11.2/bullseye-backports</pre> <p>will attempt to install all variants of the given kernel and will result in an installation failure.</p> |
|----|---|

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

#### 4.3. open-vm-tools are now available in Debian repos

As of 17-Feb-2022, Debian has made open-vm-tools and open-vm-tools desktop packages available for Debian 11 in their "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. Fedora

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### 5.1. General notes

The Fedora Project maintains each release of Fedora Linux for approximately 13 months. For a version N of Fedora Linux, the End of Life (EOL) date is about 1 month after the release of the N+2 version. EOL releases are no longer supported by the Fedora Project and do not receive further updates. See <https://docs.fedoraproject.org/en-US/releases/eol/> for information on unsupported Fedora Linux Releases.

While Fedora 35 and 36 will work with Fusion 13, they have reached their EOL dates of December 2022 and May 2023 respectively. Please use Fedora 37 or later.

Fedora 37 (released 2022-11-15) boots and installs with no issues.

Fedora 38 (released 2023-04-17) boots and installs with no issues.

Fedora Rawhide (rolling development version) boots and installs with no issues.

For all these releases:

- Console resolution can be changed from within the VM and by resizing the console window.
- 3D acceleration is supported.
- open-vm-tools and open-vm-tools-desktop are available from Fedora repos.

## 6. Kali Linux

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### 6.1. General notes

Kali Linux has been confirmed to run using Fusion 13 on Apple Silicon Macs

- Console resolution can be changed from within the VM. It can't be changed by resizing the console window 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.

Either Bare Metal or Live Boot media from the Kali web site can be used to install and run Kali. When downloading from Kali's web site, ensure you select media labelled for "Apple M1". Media labelled as "32-bit" or "64-bit" are for Intel CPUs. Do not use any pre-packaged virtual machines, even if they are labelled for use under VMware. Those are for Intel architecture CPUs.

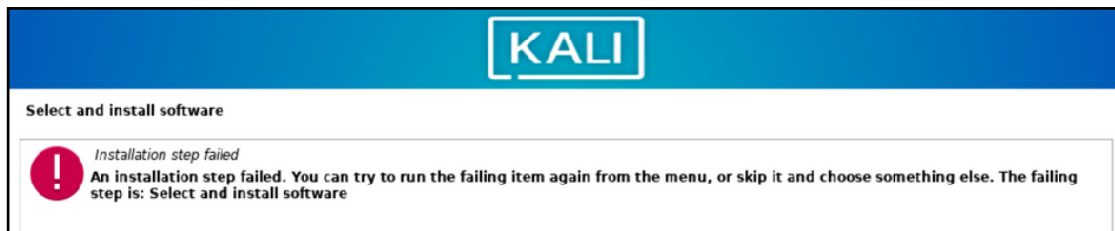
When creating a new virtual machine, do not drag and drop the Kali ISO file on the "Create a virtual machine" dialog. Kali Linux is not an officially supported Linux ARM distribution, and the virtual machine may be configured incorrectly. Instead, use the option to "Create a custom virtual machine".

The recommended minimum virtual machine configuration for Kali Linux is:

- Guest operating system type of "Debian 11.x 64-bit Arm"
- 2 Virtual CPUs
- 4096 MB memory
- 20 GB virtual hard drive

### 6.2. 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.

### 6.3. 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 graphics resolution. The graphics resolution can be changed within the VM, which will then change the window size.

According to @Mikero, this is an issue with the default XFCE window manager that Kali uses. Screen resizing will work for KDE, GNOME, and Cinnamon, but not XFCE.

## 7. macOS

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### 7.1. macOS virtualization is not supported by Fusion on Apple Silicon

Per VMware KB article <https://kb.vmware.com/s/article/90364>, Fusion 13 on Apple Silicon does not support virtualization of any macOS version.

If you want to run a VM with a macOS version older than macOS 12 Monterey, you must use an Intel Mac<sup>5</sup>.

If you want to virtualize macOS 12 Monterey or macOS 13 Ventura 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 are the same, but the App Store version gets you 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.

All three of these products have identical capabilities for virtualizing macOS. They all use Apple's high level Virtualization Framework to run macOS VMs on Monterey and Ventura hosts. Because of this, the following capabilities are not supported by these products:

<ul style="list-style-type: none"><li>• Virtualization of macOS 11 Big Sur</li><li>• Running of more than 2 macOS VMs at once</li><li>• Resizing of virtual disks</li><li>• Virtual disk snapshots</li><li>• Drag/drop of files between host Mac and VM.</li></ul>	<ul style="list-style-type: none"><li>• Suspend/resume of VMs</li><li>• Connection of USB devices to the VM</li><li>• Inability to sign in with an Apple ID in the VM</li><li>• Connection of USB devices to the VM</li></ul>
--	---

Some community members indicate that there is a developer preview of Oracle VirtualBox 7 for Apple Silicon. The VirtualBox developers consider it to be highly experimental and potentially buggy with “modest performance”<sup>6</sup>. It is not clear whether this preview release supports macOS virtualization.

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<sup>5</sup> 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.

<sup>6</sup> Editor's comment: I read this as a kind way of saying “poor performance”.

## 8. OpenSUSE Leap

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### 8.1. General notes

OpenSUSE Leap (“Leap”) versions 15.3 and earlier have reached their End-of-Life and should not be used. Use Leap 15.4

Leap 15.4 will install and run on Fusion 13.

- Console resolution can be changed from within the VM.
- No 3D acceleration support.
- open-vm-tools and open-vm-tools-desktop are available from Leap repos.
- Leap 15.4 installers may hang at “Starting udev”. The topic [Leap 15.4 installer hangs at “Starting udev”](#) contains a workaround to this issue.

Leap 15.5 beta will install on Fusion 13.

- It does not exhibit the hang at “Starting udev” issue.
- Console resolution can be changed from within the VM
- No 3D acceleration support.
- open-vm-tools and open-vm-tools-desktop are available from Leap repos.

Note that during the installation of any version of Leap you must create a custom virtual machine. Do not drag/drop the ISO on the “New Virtual Machine” dialog. See the topic [Installing from ISO error - the VM needs x86 architecture](#).

### 8.2. 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:

Procedure: Disabling the vmwgfx driver for Leap 15.4	
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”): <code>modprobe.blacklist=vmwgfx</code>
4.	Press <b>Ctrl-x</b> 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 updates, the kernel in the installed VM will be a newer version that will support the use of the `vmwgfx` driver. To enable use of the `vmwgfx` driver once the kernel is updated, use the Boot Loader module of YaST to remove the kernel boot argument added in step 3 above.

This issue is not present in Leap 15.5 beta releases.

### 8.3. Installing from ISO error - the VM needs x86 architecture

When creating a new virtual machine by dragging and dropping any version of the Leap installation ISO onto the Fusion "Select the Installation Method" dialog, an error message stating that the virtual machine requires an x86 machine architecture is displayed.. This appears even though the installation media has been confirmed to be an arm64 architecture version. The virtual machine operating system type will also be set to "OpenSUSE", which is not one of the available choices in the Fusion GUI for a new virtual machine on Apple Silicon.

This behavior is a bug in Fusion 13. The "drag/drop" method does not properly recognize the arm64 install ISO and is creating an improper VM configuration. To work around this issue, use the following procedure to create and install a virtual machine for Leap:

Procedure: Installing Leap 15.4/15.5 Beta from ISO installation media	
1.	From the Fusion GUI menu bar, select File -> New. The "Select the Installation Method" dialog will appear.
2.	In the "Select the Installation Method" dialog: <ul style="list-style-type: none"><li>• Click on "Create a custom virtual machine".</li><li>• Click "Continue".</li></ul>
3.	In the "Choose Operating System" dialog: <ul style="list-style-type: none"><li>• Select a Linux operating system of "Other Linux 5.x kernel 64-bit Arm".</li></ul> Note the lack of a "OpenSUSE" option here.
4.	In the "Choose a Virtual Disk" dialog: <ul style="list-style-type: none"><li>• Accept the default answer to create a new virtual disk.</li><li>• Click "Continue".</li></ul>
Procedure continues on the next page	

Procedure: Installing Leap 15.4/15.5 Beta from ISO installation media (continued)	
5.	<p>In the “Choose a Virtual Disk” dialog:</p> <ul style="list-style-type: none"> <li>Click “Customize Settings”.</li> </ul> <p>Do not click “Finish”.</p>
6.	Select a name for the new virtual machine and save it.
7.	<p>The Settings dialog for the new virtual machine will appear.</p> <p>Make the following changes to the virtual machine configuration:</p> <p><b>Processors and Memory:</b> Change the number of CPUs and memory for the virtual machine. 2 virtual processors and 4096 MB of memory are a good start.</p> <p><b>Hard Disk (NVMe):</b> Increase the disk size. 20 GB is a good start.</p> <p><b>CD/DVD (SATA):</b> Configure the virtual CD/DVD device to use the OpenSUSE Leap installation ISO. Ensure the “Connect CD/DVD Drive” checkbox is checked.</p>
8.	Boot the virtual machine to start the installer

## 9. OpenSUSE Tumbleweed

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### 9.1. General notes

OpenSUSE Tumbleweed (“Tumbleweed”) is a continually updated or rolling distribution. It is released as “snapshots”<sup>7</sup>. See the Tumbleweed documentation for a more detailed explanation of how Tumbleweed is released and updated.

Tumbleweed will install and run on Fusion 13.

- Console resolution can be changed.
- 3D acceleration is supported by the kernel and Mesa3D.
- open-vm-tools and open-vm-tools-desktop are available from Tumbleweed repos.

### 9.2. Creating an OpenSUSE Tumbleweed VM

Unlike OpenSUSE Leap, a Tumbleweed VM can be created by dragging/dropping the installation ISO on the Fusion “Select the Installation Method” dialog.

In the “Choose Operating System” dialog, set the operating system type to “Other Linux 5.x kernel 64-bit Arm”.

The resulting VM configuration of an 8 GB hard disk and 768 MB of memory is not sufficient for running Tumbleweed. Before powering on the virtual machine, modify the VM’s configuration:

- Set the VM’s memory to a minimum of 4096 MB.
- Increase the hard disk size to 20GB or more. This will give sufficient space for future upgrades.

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<sup>7</sup> 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.

## 10. Oracle Linux

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### 10.1. General notes

The only kernel available for Oracle Linux on aarch64 (ARM) architectures is Oracle's Unbreakable Enterprise Kernel (UEK). The Red Hat Compatible Kernel (RHCK) is only available for x86\_64 (Intel) architectures.

UEK R6 and earlier will not run on Apple Silicon CPUs. Like RHEL 8, they are compiled with a 64 KB page size which is incompatible with Apple Silicon hardware. See the topic [RHEL 8 and earlier fail to boot](#) in the section on Red Hat Enterprise Linux for more information. Oracle Linux versions prior to 8.7 can not be used with Fusion 13 on Apple Silicon as they use UEK R6 or earlier kernels.

UEK R7 kernels are compiled with a 4 KB page size and will run on Apple Silicon CPUs. Oracle Linux 8.7, 9.0, and 9.1 all use UEK R7 kernels and will run in a Fusion 13 VM on Apple Silicon.

### 10.2. No open-vm-tools for Oracle Linux 8.7

Oracle does not provide the packages for 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.x

## 11. Red Hat Enterprise Linux and downstream distros

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### Note:

References to Red Hat Enterprise Linux (RHEL) in this section also apply to “compatible” or “downstream” distributions based on 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](#).

### 11.1. General notes

RHEL 9.1 or later provides the best experience under Fusion 13. RHEL 9.0 will run but has issues which have been fixed in RHEL 9.1.

- Console resolution can be changed.
- 3D acceleration is not supported.
- open-vm-tools and open-vm-tools-desktop are available from RHEL 9 repos.

When creating a RHEL 9 (or compatible/downstream distribution) virtual machine, set the operating system type to "Red Hat Enterprise Linux 9 64-bit Arm".

### 11.2. RHEL 8 and earlier do not work

Per VMware KB article <https://kb.vmware.com/s/article/90364>, RHEL 8 and earlier are not supported on Apple Silicon and will not work. They will fail to boot on Fusion 13. Attempts to use these distributions will get into a “boot loop”. A 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 13.

No workaround is available to make these kernels boot. VMware has no plans 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.

## 12. Ubuntu

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### 12.1. General notes

Ubuntu arm64 releases known to work on Fusion 13 are:

- 20.04.5 LTS (Focal Fossa).
- 22.04.2 LTS (Jammy Jellyfish) - earlier 22.04 installers do not boot.
- 22.10 (Kinetic Kudu). This release works but should be avoided if possible. There are issues with the latest kernel updates to Ubuntu 22.10. See the topic [Blank console display in Ubuntu 22.10 with kernel 5.19.0-31](#) for a workaround for this issue.
- 23.04 (Lunar Lobster)<sup>8</sup>

According to VMware KB article <https://kb.vmware.com/s/article/90364> earlier releases of Ubuntu 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 13.

### 12.2. Ubuntu 22.04 and 22.04.1 LTS installers do not boot

The ISOs for Ubuntu 22.04 and 22.04.1 LTS will not boot on Fusion 13. Use the installer for Ubuntu Server 22.04.2 LTS to install an Ubuntu 22.04 virtual machine.

### 12.3. Ubuntu Desktop 22.04 daily builds fail to boot

It has been reported by @gsmgmt that the 22.04 daily builds of Ubuntu Desktop fail to boot. This is most likely due to the issue described in the topic [Blank console display in Ubuntu 22.10 with kernel 5.19.0-31](#).

Use the Ubuntu Server 22.04.2 LTS ISO to install an Ubuntu 22.04 virtual machine. “Convert” the Ubuntu Server using the procedure in the topic [How to convert Ubuntu Server to Ubuntu Desktop](#) if you require Ubuntu Desktop.

### 12.4. Do not use Ubuntu 22.04.2 HWE kernels

The HWE (Hardware Enablement) kernels of Ubuntu 22.04.2 suffer from the same issue as described in the topic [Blank console display in Ubuntu 22.10 with kernel 5.19.0-31](#).

- When installing 22.04.2, do not select the HWE kernel installation option. Use the default installation selection.
- In an existing 22.04 installation., do not install the HWE kernel packages. They are not needed.

Canonical indicates that they will probably release an updated HWE kernel that fixes this issue once the fixes are released for 22.10.

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<sup>8</sup> 23.04 daily builds for arm64 have re-appeared, but they are broken. You can't log into it. Use 23.04 Server instead.

## 12.5. Blank console display in Ubuntu 22.10 with kernel 5.19.0-31


Attempting to boot an Ubuntu 22.10 VM that has installed kernel version 5.19.0-31 or later will result in a blank display on the VM's console window. You will think that the VM has failed to boot since nothing displays on the VM's console. The virtual machine has booted and will be running "headless" behind the scenes.

This issue is not present in Ubuntu 22.04 LTS standard kernels and Ubuntu 23.04.

Canonical has acknowledged through a bug report that a Linux kernel patch they inadvertently included in these kernels is causing the problem. They have fixed the issue in their development versions of the kernel. They indicate that this fixed version should be released as an update to 22.10 sometime in early June 2023. Until then, use one of the following workarounds for this issue.

**Workaround 1: Don't upgrade the kernel.** The last known working kernel for 22.10 is the 5.19.0-29 version. If you are currently running a VM with this kernel version (or an earlier one), you can avoid this issue by not installing further Ubuntu 22.10 software updates.

**Workaround 2: Install a working kernel.** If the VM has been updated to one of the impacted kernel versions (either in a new VM installation or through software updates), use the following procedure to recover from the broken kernel and install a kernel that does not exhibit this issue.

Procedure: Recovering from installation of 5.19.0-31 kernel on Ubuntu 22.10	
1.	Boot the VM and wait a few minutes for it to complete the boot process.
2.	<p>Find the IP address of the VM. It can be found by highlighting the VM's name in the left-hand panel of the Virtual Machine Library and looking toward the bottom of the right-hand panel. Here's an example of what you should see:</p>  <p>The screenshot shows the Virtual Machine Library interface. At the top, there's a blacked-out title bar. Below it, the VM name 'Ubuntu 22.10' is displayed with its logo. Underneath, the kernel version 'Linux 5.19.0-31-generic' and other identifiers are listed. At the bottom, system specifications are shown: '2 Processor Cores', '4096 MB Memory', 'IP: 192.168.4.147' (highlighted with a red box), 'MAC: 00:0C:29:7B:AF:AA', and 'Hard Disks'.</p>
3.	Once you have the IP address of the VM, open the Mac's Terminal app.
Procedure continues on the next page	

Procedure: Recovering from installation of 5.19.0-31 kernel on Ubuntu 22.10 (continued)	
4.	<p>Use ssh to remotely log into the VM:</p> <pre>\$ ssh username@ip-address</pre> <p>Where <b>username</b> is a username with admin privileges in the VM, and <b>ip-address</b> is the IP address of the VM.</p> <p>You may be asked about the authenticity of the ssh fingerprint for the VM if this is the first time you’ve logged into the VM with ssh. If this happens, accept the fingerprint.</p>
5.	<p>Perform the steps in the procedure <a href="#">Making Ubuntu always show the GRUB boot loader menu</a>. These steps are necessary to allow the selection of an alternate kernel at boot time.</p>
6.	<p>Perform <b>either A or B</b> to install a kernel that does not have the issue.</p> <p><b>A.</b> Install the 5.19.0-29 kernel from Ubuntu’s repos if it is not installed:</p> <pre>\$ sudo apt install linux-image-5.19.0-29-generic \$ sudo apt install linux-modules-5.19.0-29-generic \$ sudo apt install linux-modules-extra 5.19.0-29-generic</pre> <p>Mark the kernel so that it does not get auto removed by future updates.</p> <pre>\$ sudo apt-mark hold linux-image-5.19.0-29-generic \$ sudo apt-mark hold linux-modules-5.19.0-29-generic \$ sudo apt-mark hold linux-modules-extra 5.19.0-29-generic</pre> <p><b>B.</b> Use the procedure in the topic <a href="#">How to find and install “mainline” kernels</a> to install the “mainline” utility and install a newer kernel. For example, the 6.2.11 kernel successfully used by the editor can be installed by using the following command:</p> <pre>\$ sudo mainline --install 6.2.11</pre>
7.	<p>Reboot the VM</p>



The GRUB boot loader menu will now appear each time you boot the VM:



When the boot loader menu appears, and before the 10 second menu timeout, use the keyboard up/down arrow keys and select “**Advanced options for Ubuntu**”. The boot menu will then display a list of kernels that are installed. Here's an example:



Use the keyboard up/down arrow keys to select the kernel version you installed in step 6 of the procedure above. Don't use any marked with “(recovery mode)”. Press “Return” or “Enter” to boot the selected kernel.

Keep this workaround in place until Canonical releases an updated kernel that fixes the issue. At that point you can remove the kernel you installed as a workaround.

## 12.6. Canonical does not release Ubuntu Desktop for ARM

Canonical does not provide a GA (generally available) version of Ubuntu Desktop for ARM. The only GA releases that you will find for ARM on their Ubuntu download pages are for Ubuntu Server.

To install an Ubuntu VM that is almost identical to Ubuntu Desktop on Intel, try one of the following:

- Install Ubuntu Server, then “convert” it to an Ubuntu Desktop equivalent using the procedure in the topic [How to convert Ubuntu Server to Ubuntu Desktop](#), or
- Use the Ubuntu Desktop daily development builds as noted in the section [Links to Ubuntu Downloads](#) if they are available.

## 12.7. How to convert Ubuntu Server to Ubuntu Desktop

By adding a few packages and making a configuration change, an Ubuntu Server VM can be “converted” into the equivalent of an Ubuntu Desktop VM. 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/>.

Procedure: “Converting” Ubuntu Server to Ubuntu Desktop	
1.	Boot the Ubuntu Server VM and log in.
2.	Install additional required packages. <pre>\$ sudo apt install ubuntu-desktop open-vm-tools-desktop \$ sudo snap install snap-store</pre>
3.	Disable the use of systemd-networkd for networking management. <pre>\$ sudo systemctl disable systemd-networkd.service \$ sudo systemctl mask systemd-networkd.service \$ sudo systemctl stop systemd-networkd.service</pre>
4.	Save a copy of the .yaml file found inside the /etc/netplan directory. <pre>\$ cp /etc/netplan/*.yaml ./</pre>
Procedure continues on the next page	

Procedure: “Converting” Ubuntu Server to Ubuntu Desktop (continued)	
5.	<p>Edit the <code>.yaml</code> file found inside the <code>/etc/netplan</code> 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 <code>sudo</code> as the <code>.yaml</code> file is owned by root.</p> <p>Example using the <code>vi</code> text editor:</p> <pre>\$ cd /etc/netplan \$ sudo vi 00-installer-config.yaml</pre>
6.	<p>Replace the entire contents of the <code>.yaml</code> file with the following:</p> <pre>network:   version: 2   renderer: NetworkManager</pre>
7.	<p>Set the system to use NetworkManager for networking management.</p> <pre>\$ sudo netplan generate \$ sudo systemctl unmask NetworkManager \$ sudo systemctl enable NetworkManager \$ sudo systemctl start NetworkManager</pre>
8.	<p>Update boot files</p> <pre>\$ sudo update-initramfs -u -k all</pre>
9.	<p>Reboot the VM</p> <pre>\$ sudo systemctl reboot</pre>

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

## 12.8. Links to Ubuntu downloads

Here are direct links to Ubuntu installer ISOs that will work on Fusion 13.

Note: These links were verified as of 20-Apr-2023. They may change without notice.

Ubuntu Version	Download Link
20.04.5 LTS (Focal Fossa) Server	<a href="https://cdimage.ubuntu.com/ubuntu/releases/20.04.5/release/ubuntu-20.04.5-live-server-arm64.iso">https://cdimage.ubuntu.com/ubuntu/releases/20.04.5/release/ubuntu-20.04.5-live-server-arm64.iso</a>
20.04.5 LTS (Focal Fossa) Desktop daily build	<a href="https://cdimage.ubuntu.com/focal/daily-live/current/focal-desktop-arm64.iso">https://cdimage.ubuntu.com/focal/daily-live/current/focal-desktop-arm64.iso</a>
22.04.2 LTS (Jammy Jellyfish) Server	<a href="https://cdimage.ubuntu.com/releases/22.04.2/release/ubuntu-22.04.2-live-server-arm64.iso">https://cdimage.ubuntu.com/releases/22.04.2/release/ubuntu-22.04.2-live-server-arm64.iso</a>
22.04.2 LTS (Jammy Jellyfish) Desktop Daily build	The daily builds contain a broken kernel. Use 22.04.2 LTS Server and <a href="#">"convert" to Ubuntu Desktop</a> .
22.10 (Kinetic Kudu) Server	<a href="https://cdimage.ubuntu.com/ubuntu/releases/kinetic/release/ubuntu-22.10-live-server-arm64.iso">https://cdimage.ubuntu.com/ubuntu/releases/kinetic/release/ubuntu-22.10-live-server-arm64.iso</a>
22.10 (Kinetic Kudu) Desktop	Not available. Use 22.10 Server, use the procedures to <a href="#">recover from the 22.10 blank console screen problem</a> , and <a href="#">"convert" to Ubuntu-Desktop</a> .
23.04 (Lunar Lobster) Server	<a href="https://cdimage.ubuntu.com/releases/23.04/release/ubuntu-23.04-live-server-arm64.iso">https://cdimage.ubuntu.com/releases/23.04/release/ubuntu-23.04-live-server-arm64.iso</a>
23.04 (Lunar Lobster) Desktop daily build	Doesn't work due to Ubuntu packaging issues. Use 23.04 Server and <a href="#">"convert" to Ubuntu Desktop</a> .

## 12.9. Making Ubuntu always show the GRUB boot loader menu

The GRUB boot loader's boot menu is useful in situations where a kernel update (or other circumstance) requires a manual modification to the Linux boot process. Unfortunately, Ubuntu may not display the GRUB boot prompt by default - especially if you have installed Ubuntu from a daily desktop version build.

Ubuntu documentation does describe how to display the GRUB boot loader menu during boot, but these instructions are inconvenient and rely on manual dexterity and “just right” timing to get it to work. Most people can’t get the process to work for them reliably.

The boot process can be changed to always display the GRUB boot loader menu without using the error-prone documented methods. This gives you more time to select either the default kernel or an alternate kernel for booting.

Procedure: Modifying Ubuntu boot defaults to always show the GRUB menu	
1.	Log into the VM.
2.	Sudo to a root shell, and edit <code>/etc/default/grub</code> :
3.	<p>Change the line containing</p> <pre>GRUB_TIMEOUT_STYLE=hidden</pre> <p>to</p> <pre>GRUB_TIMEOUT_STYLE=menu</pre> <p>This will allow GRUB to always display its menu at boot.</p>
4.	<p>Change the line containing</p> <pre>GRUB_TIMEOUT=0</pre> <p>to</p> <pre>GRUB_TIMEOUT=10</pre> <p>GRUB_TIMEOUT is the delay (in seconds) until the default kernel is booted once the boot menu appears. During the delay, an alternate boot selection can be made by using the keyboard up/down arrow keys. A delay of 10 seconds is recommended; another value can be used if desired.</p>
5.	Save the changes and exit the editor.
6.	<p>Update the grub configuration:</p> <pre># update-grub</pre>

From this point onward, the GRUB boot menu will always appear at VM boot. You will have 10 seconds to select an alternative to booting the default kernel.

## 12.10. How to find and install “mainline” kernels

Ubuntu has alternative kernel builds that they refer to as “mainline” kernels. These kernels are builds of Linux kernels directly from upstream Linux kernel repositories using Ubuntu kernel configuration files. They are not officially supported by Ubuntu for production use and receive no security updates. See <https://wiki.ubuntu.com/Kernel/MainlineBuilds> for more information.

In most cases these kernels can be used instead of the standard Ubuntu kernel. In some cases, they can be used to work around problems introduced by Ubuntu in their standard kernels until those problems are officially fixed.

### Note:

Mainline kernel versions 5.19 and later can be installed on Ubuntu 22.04 LTS, and 22.10. Do not attempt to install a 5.19 or later mainline kernel on Ubuntu 20.04 LTS. These kernels have dependencies that are not met by 20.04 and will not install.

“Mainline” kernels can be found at <https://kernel.ubuntu.com/~kernel-ppa/mainline>. They are organized by kernel versions.

Instead of downloading the packages from the Ubuntu web site and installing them manually, the open source “mainline” utility provides a simpler way to list, install, and uninstall these kernels.

There is no pre-built package for “mainline” available for arm64 Linux, so you’ll need to build it yourself. Use the following procedure to download and build the “mainline” utility.

Procedure: Building and installing the "mainline" utility	
1.	Log into the VM.
2.	Install pre-requisite packages for building and running the “mainline” utility: <pre>\$ sudo apt install libgee-0.8-dev libjson-glib-dev libvte-2.91-dev \$ sudo apt install valac aria2 lsb-release aptitude \$ sudo apt install make gettext dpkg-dev</pre>
3.	Download the sources for "mainline" <pre>\$ git clone https://github.com/bkw777/mainline.git</pre>
4.	Build and install the "mainline" utility. The utility will be installed in /usr/bin. <pre>\$ cd mainline \$ make \$ sudo make install \$ make clean</pre>

The “mainline” utility has two versions:

- A command line version “mainline”
- A GUI version “mainline-gtk”

#### Examples for the command line version of mainline

- List options for the “mainline” utility.

```
$ mainline --help
```

- List all of the mainline kernels available:

```
$ mainline --list
```

- Install the 6.1.12 mainline kernel:

```
$ sudo mainline --install 6.1.12
```

- Uninstall the 6.1.12 mainline kernel (this assumes you are not currently running on the 6.1.12 kernel):

```
$ sudo mainline --uninstall 6.1.12
```

## 13. Windows 11 ARM

---

### 13.1. 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 13 on Apple Silicon Macs<sup>9</sup>.

Fusion 13 provides the virtual hardware features required by Windows 11 (both UEFI Secure Boot and Trusted Platform Module) as well as device drivers for VMware 2D graphics and networking.

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

You can obtain installation media for your Windows 11 ARM virtual machine by

- using the procedure in the topic [Obtaining Windows 11 ARM ISO installation media](#) to build the ISO from Microsoft's ESD distribution, or
- using ISO media generated by Parallels Desktop 17.

It is no longer recommended or necessary to:

- Build ISO media from uupdump.net
- Use converted Windows 11 ARM Insider Preview VHDX files for VM installation.

Installation instructions for these two installation procedures been removed from the Companion Guide as of version 12. The current procedures easier to use, faster, and more reliable.

### 13.2. Video walk through of installation procedures

A community member (thank you @santhonysasse) has provided a video that walks you through the steps found in this Guide for installing Windows 11 ARM in Fusion 13. The video can be found at [https://youtu.be/FUSLJnxKa\\_4](https://youtu.be/FUSLJnxKa_4).

Skip over the sections in the video that instructs you to install Homebrew and use it to install aria2 and wimlib packages. Those steps are no longer required with version 3.0 of the w11arm\_esd2iso utility.

### 13.3. Windows 11 ARM licensing

Microsoft Windows is not a free product. Please respect Microsoft licensing policies and obtain licenses for Windows 11 ARM VMs that you use under Fusion 13.

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<sup>9</sup> 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.



Microsoft allows retail licenses for Windows 11 Home or Professional (even if purchased for PCs) to activate Windows 11 ARM. These licenses will activate Windows 11 installed on a Fusion VM. If you don't have a license, purchase it from any vendor selling genuine Microsoft licenses. You also can purchase a license directly from Microsoft from within the VM once it is running.

There are reports from the community that Windows 10 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.

### 13.4. Obtaining Windows 11 ARM ISO installation media

#### Notes:

Ensure you have a minimum of 15 GB of free disk space on your Mac before starting this procedure. The tool used to create the ISO media will enforce this.

This procedure runs only on macOS Ventura and Apple Silicon Macs. This guide does not provide instructions on how to build the ISO media on any other operating system platform.

Use of Homebrew or MacPorts to install open source utility packages is no longer required. The `w11arm_esd2iso` utility bundles everything it needs starting in version 3.0. Appendices that described how to install utilities from Homebrew or MacPorts have been removed from the Companion Guide as they are no longer necessary

Use the following procedure on your Mac to create an installation ISO of Windows 11 ARM from an ESD (electronic software distribution) file obtained from Microsoft:

#### Procedure: Creating Windows 11 ARM ISOs from Microsoft ESD

1.	Download the <code>w11arm_esd2iso</code> ISO creation utility version 3.0 or later from the VMware Fusion Documents forum at the following link: <a href="https://communities.vmware.com/t5/VMware-Fusion-Documents/w11arm-esd2iso-a-script-to-create-Windows-11-ARM-ISOs-from/ta-p/2957381">https://communities.vmware.com/t5/VMware-Fusion-Documents/w11arm-esd2iso-a-script-to-create-Windows-11-ARM-ISOs-from/ta-p/2957381</a> The downloaded file will be named <code>w11arm_esd2iso-v3.0.zip</code> . The exact name represents the version of the utility contained in the zip file.
2.	Use the Finder to create a folder named "Build" on the desktop. Move the downloaded zip file from the Downloads folder to the Build folder.

Procedure continues on the next page

Procedure: Creating Windows 11 ARM ISOs from Microsoft ESD (continued)	
3.	<p>Open the Terminal app and change the working directory to the Build folder on the Desktop</p> <pre>\$ cd ~/Desktop/Build</pre>
4.	<p>Unzip the file you moved into the Build folder. Example:</p> <pre>\$ unzip wllarm_esd2iso-V3.0.zip</pre> <p>The following files should be extracted:</p> <pre> README wllarm_esd2iso wllarm_esd2iso_manpage.pdf<sup>10</sup> (documentation) bin/ (folder containing additional required utilities) doc/ (folder containing additional documentation and copying info) lib/ (directory containing additional required utilities) </pre>
5.	<p>Execute the utility to display the available Windows languages that are supported.</p> <pre>\$ ./wllarm_esd2iso -l</pre> <p>(That's a lower-case L, not the number 1).</p> <p>Note the language/region tag for the language of Windows that you wish to install. You will use this in step 6.</p>
6.	<p>Execute the utility to download and create the ISO file:</p> <pre>\$ ./wllarm_esd2iso language-tag</pre> <p>where <i>language-tag</i> is the language/region tag obtained in Step 7 .</p> <p>Example for US English (language tag “en-us”)</p> <pre>\$ ./wllarm_esd2iso en-us</pre> <p>The utility will create the Windows 11 ARM ISO and place it in the Build directory. You can track its progress as it executes the steps needed for the process.</p> <p>If the utility can’t recover from network issues that interrupt the download from Microsoft, it will display a command that can be copy/pasted to restart the download process. The download will resume from the point where the interruption occurred, saving both time and network bandwidth.</p> <p>The utility will clean up all work files that it used during the download and build process.</p>

<sup>10</sup> Please take the time to read both the README and the documentation pdf. They contain more detailed information about the utility and its operation.

The first step of the utility that downloads the ESD file from Microsoft can take as little as 2 minutes on a 500Mbit fiber Ethernet connection. Your time will vary based on your Internet connection speed and stability. Once the utility downloads the ESD file from Microsoft, the remaining steps of the ISO creation process take about 4-7 minutes.<sup>11</sup>

Once the ISO is created, continue with the topic [Creating the VM and installing Windows 11 from ISO](#).

### 13.5. Creating the VM and installing Windows 11 from ISO

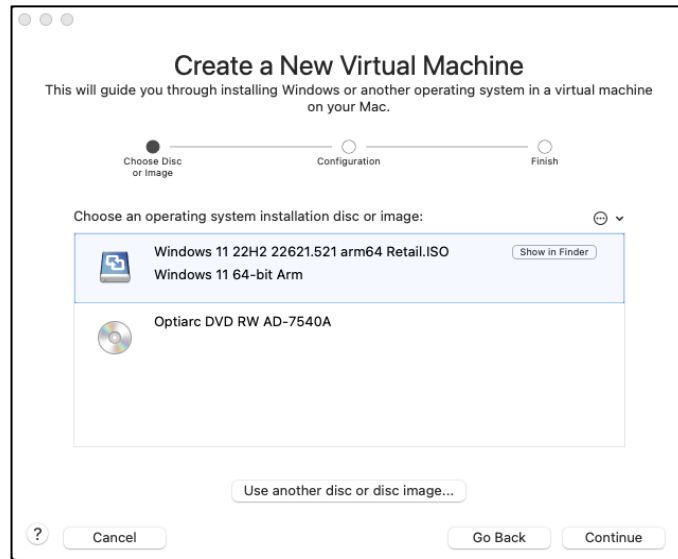
Use the following procedure to create the virtual machine and install Windows 11 ARM from ISO media.

Procedure: Creating the VM and installing Windows 11 from ISO	
1.	Create a new virtual machine by clicking “ <b>File &gt; New...</b> ” in the Fusion menu bar.
2.	<p>In the “<b>Select the Installation Method</b>” dialog, drag and drop the Windows 11 ARM ISO from the Finder to the area marked “<b>Install from disc or image</b>”.</p> <div data-bbox="505 936 1109 1470"></div> <p>Click “<b>Continue</b>”.</p>

<sup>11</sup> These times should be on-par with the time it takes Parallels to download installation media "from Microsoft" when creating a Windows 11 VM. It's not surprising since they use a similar process.

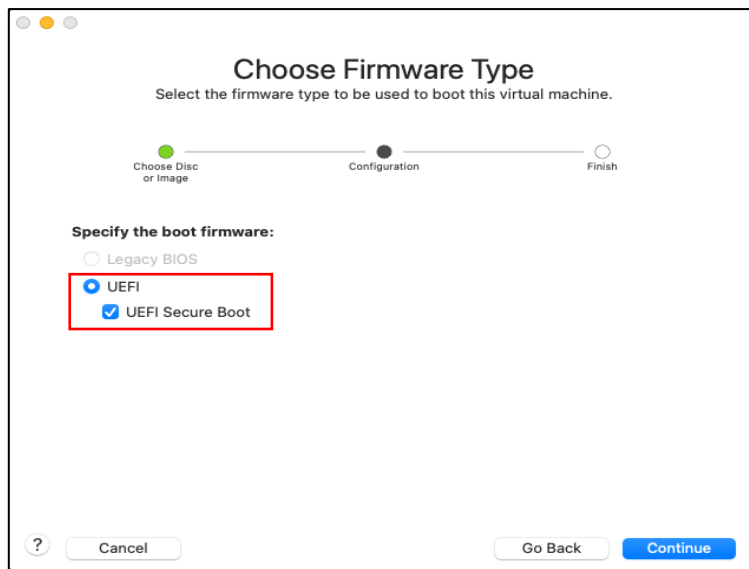
## Procedure: Creating the VM and installing Windows 11 from ISO

3. The ISO will be detected as a Windows 11 ARM ISO in the “**Create a New Virtual Machine**” dialog that follows:



Click “**Continue**”.

4. The “**Choose Firmware Type**” dialog will appear:



Check the “**UEFI Secure Boot**” check box. This is especially important if you’re running Fusion Player, as there’s no ability in the VM’s settings to change this later in Fusion Player.

Click “**Continue**”.

## Procedure: Creating the VM and installing Windows 11 from ISO

5. The “**Choose Encryption**” dialog will appear.



Select “**Only the files needed to support a TPM are encrypted**”. This only encrypts the portions of the VM needed to support the TPM and secure enclave with a minimal performance impact to a running VM.

*Do not choose the “**All the files**” option unless you really, really need to.* Choosing this option will make Fusion perform encryption/decryption for every I/O to the virtual disk, degrading performance of the VM.

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

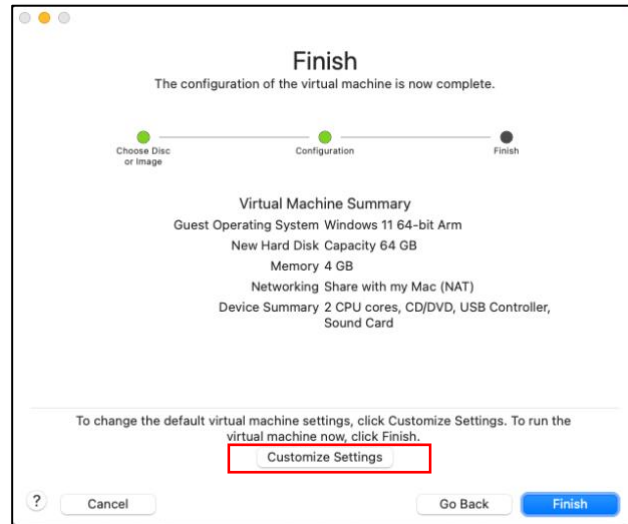
In most cases, select “**Remember Password and store it in Mac’s Keychain**”. This is especially important if you auto-generate the password. With this option enabled and if you happen to forget the password, the password can be found using the Mac’s Keychain Access app. Fusion also will automatically unlock a virtual machine for you when necessary if you store the password in the Keychain.

This process will automatically add the Trusted Platform Module (TPM) device required by Windows 11 to the virtual machine configuration.

Click “**Continue**”.

## Procedure: Creating the VM and installing Windows 11 from ISO

6. At the “Finish” screen, click “**Customize Settings**” rather than “**Finish**”. This will allow you to modify 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.

7. 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 64 GB hard drive. Windows 11 will fail to install if these minimum requirements are not met.

When finished, power on the virtual machine.

8. The virtual machine will boot, and the console window will display the message:

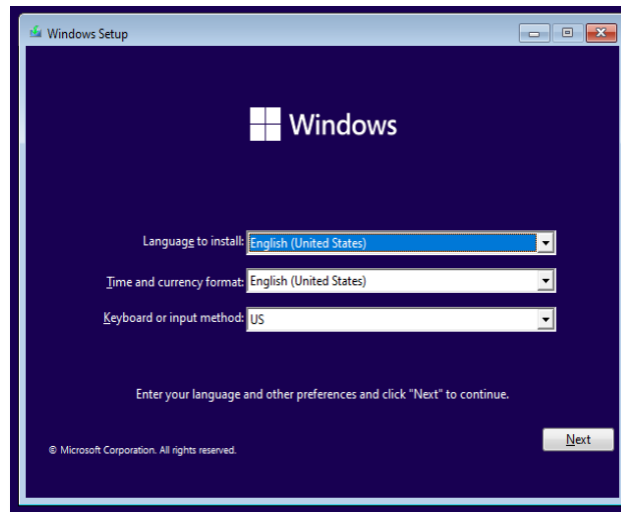
**Press any key to boot from CD or DVD**

Quickly click the mouse pointer in the virtual machine’s window (or press Command-G) and then press any key on the keyboard to continue the boot process from the ISO. Once the installer boots, go to step 9.

This prompt will time out after about 5 seconds. If it does, the installer will not start and VM will attempt to boot from the network (the “**Start PXE over ipv4**” message will be displayed). If this happens, power off the virtual machine using the Fusion GUI and power it on again. Repeat step 8.

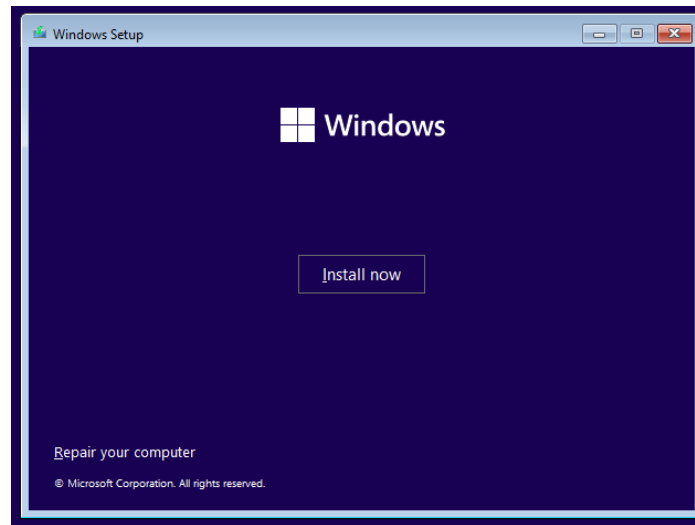
## Procedure: Creating the VM and installing Windows 11 from ISO

9. Windows Setup will start from the installation media.



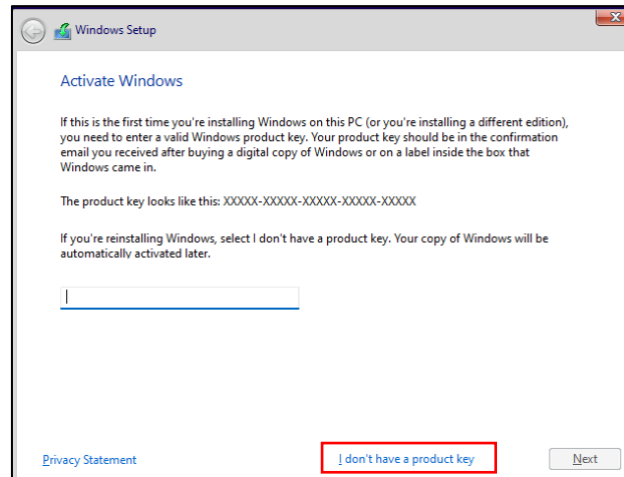
Choose your language, time/currency format, and keyboard/input method.  
Click “**Next**” to continue.

10. At this screen, click “**Install now**”.



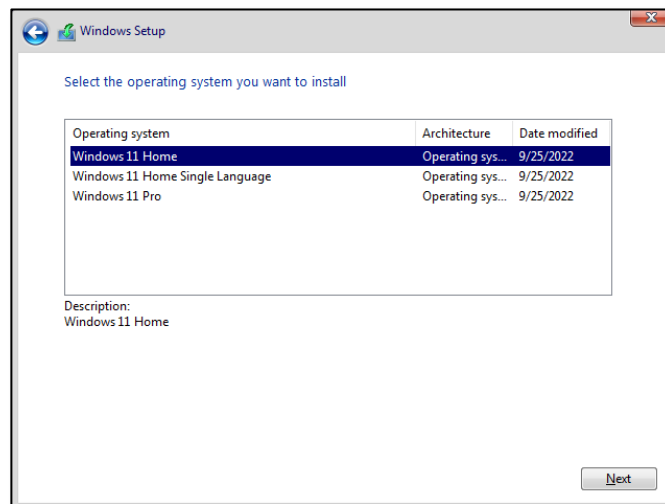
## Procedure: Creating the VM and installing Windows 11 from ISO

11. Setup will display a message asking to Activate Windows:



Click “**I don’t have a product key**” at the bottom of the window. Windows can be activated with your product key once the installation is completed.

12. Select the Windows 11 edition you wish to install from this screen.



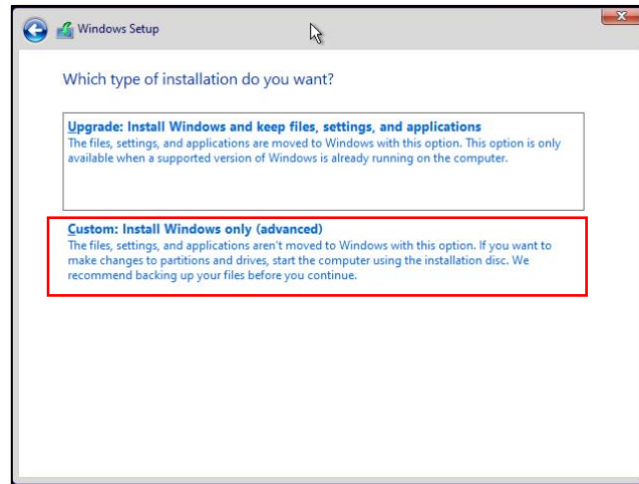
Click “**Next**” once you have selected the desired Windows edition.

13. Accept the Microsoft license terms on the next screen and click “**Next**”.



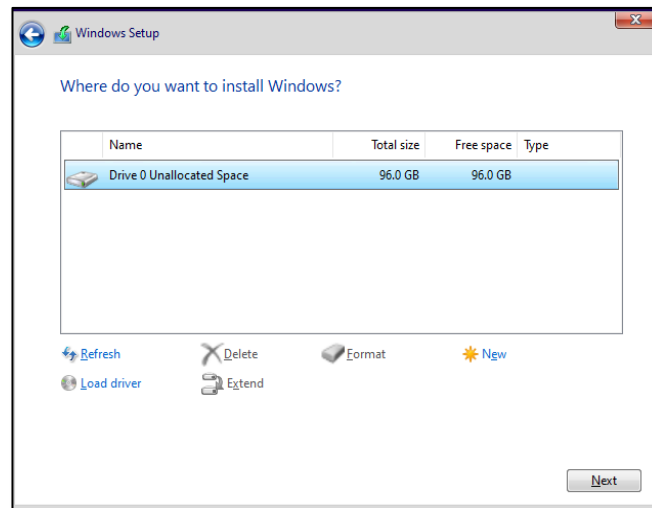
## Procedure: Creating the VM and installing Windows 11 from ISO

14. When prompted for the type of installation:



Choose **“Custom: Install Windows only (advanced)”** to perform a full installation.

15. When asked **“Where do you want to install Windows?”**, choose **“Drive 0 Unallocated Space”** which is your empty virtual hard drive.

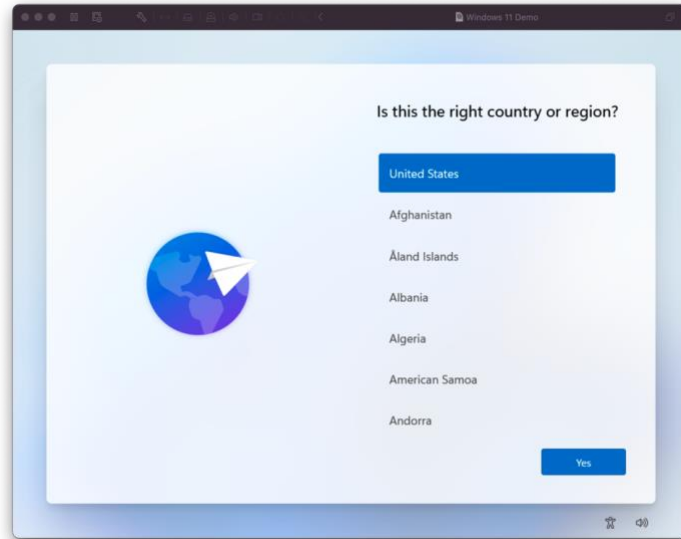


Click **“Next”**.

At this point, Windows Setup will copy files to your virtual hard drive, and reboot the VM to continue the setup process.

## Procedure: Creating the VM and installing Windows 11 from ISO

16. After the VM reboots, you will see this Windows Setup screen:



Do not click on the country/region or the **“Yes”** button. Instead, click the mouse anywhere else in the console window and press **Shift-Fn-F10** to open a command line prompt.

17. From the Fusion menu bar, select **“Virtual Machine > Install VMware Tools”**. Click **“Install”** on the next dialog when prompted. The VMware Tools ISO will be mounted to your VM as the D: drive.

Wait a few moments while the VMware Tools ISO is being mounted to the VM.

18. Return to the Windows command line window and start PowerShell

```
C:> powershell
```

The Windows command line prompt will be replaced by a PowerShell prompt.

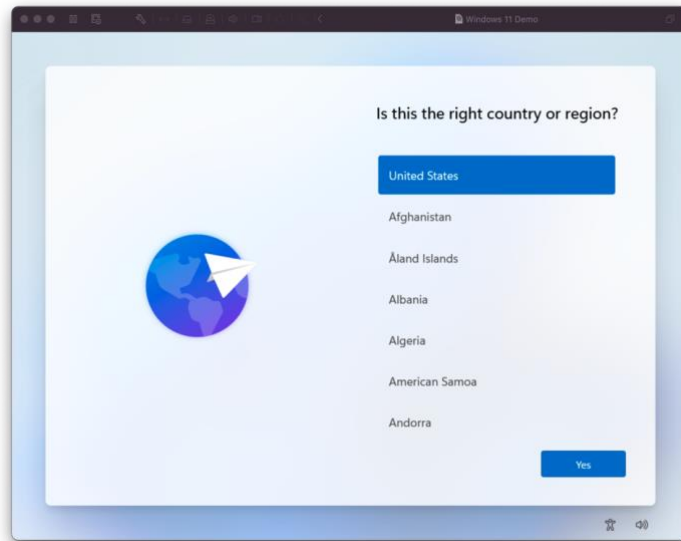
19. At the PowerShell prompt, install VMware Tools by executing the following three commands:

```
PS> cd D:\  
PS> Set-ExecutionPolicy RemoteSigned  
PS> .\setup.ps1
```

The **setup.ps1** script will install both the VMware graphics driver and the VMware network driver. The screen may blank out briefly while this happens.

## Procedure: Creating the VM and installing Windows 11 from ISO

20. Close the window that's running Powershell. You will be returned to the Windows Setup screen from step 16:



21. Continue with Windows Setup.  
You will not be prompted for a network connection because the network should now be discovered and operational with the installed VMware driver.

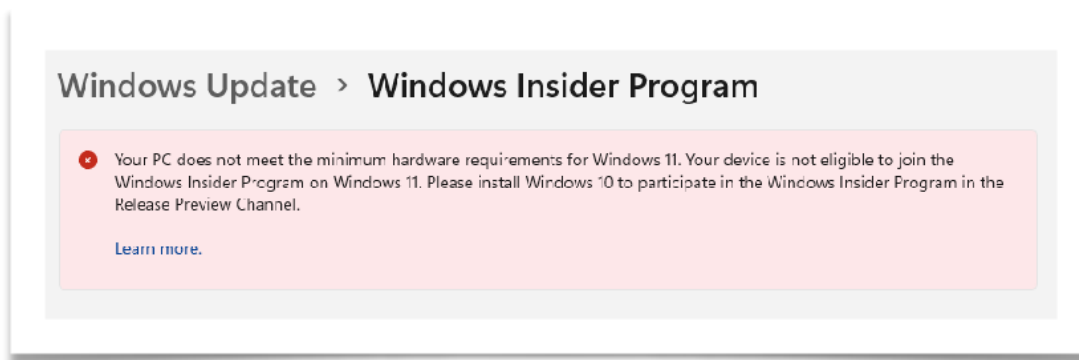
Once Windows is installed and you've successfully logged in, run Windows Update to obtain the most recent updates for Windows 11. You may need to do this more than once.

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 it installs (e.g., it crashes on open) see the topic [Microsoft Store app doesn't exist or crashes in a newly installed VM](#).

### 13.6. 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 13 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 13 on Apple Silicon.

Most users should not need to run Windows Insider builds of Windows 11. The recommended procedures in this Guide install a Windows 11 ARM Retail release sourced directly from Microsoft. The resulting VM will be kept up to date through Windows Update. Just like a “regular” Intel PC.

Note that Windows 11 Insider Preview Channel, Beta Channel, Dev Channel, or Canary Channel releases can be used with Fusion 13. If you really need to run them (and you should really think twice about it), ISOs for these other channels can be built from uupdump.net and installed on a Fusion 13 VM. 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.

### 13.7. 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 install the Microsoft Store:

Procedure: Installing the Microsoft Store app if missing	
1.	Open a Windows command prompt or Powershell as administrator.
2.	Execute the following command: <pre>PS&gt; wsreset.exe -i</pre>
3.	<p>Wait for the Microsoft Store to install. This may take a while (longer than you might expect), so please be patient.</p> <p>Up to 2 items may be installed:</p> <ul style="list-style-type: none"> <li>• Store Experience Host</li> <li>• Microsoft Store app</li> </ul> <p>Windows will provide notifications as these components are installed.</p>

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

### 13.8. Folder Sharing with the Mac host does not work

The VMware Tools included with Fusion 13 for Windows 11 ARM do not currently support Fusion's Shared Folders functionality. 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.
- **Use a Remote Desktop client**  
Access the VM that is running Windows 11 Pro or Enterprise 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.

### 13.9. Copy/paste and drag/drop does not work

Copy/paste and drag/drop does not currently work between the Mac host and a Windows 11 ARM virtual machine. This is due to Fusion 13's current lack of a full VMware Tools implementation for Windows 11 ARM.

A workaround provided by the Fusion community is to connect to the virtual machine using an RDP client such as Microsoft Remote Desktop for the Mac (which does run on Apple Silicon Macs). This will allow copy/paste between the Mac and the Windows virtual machine. Note that this will only work on Windows 11 Pro and Enterprise editions. It will not work on Windows 11 Home Editions because Microsoft does not support enabling remote desktop access on the Home Edition.

### 13.10. 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 (usually to enable Secure Boot because you didn't use the recommended VM configuration), 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"

Procedure: Change Secure Boot on Fusion Player when the 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.	Option-right click on the VM's name in the Virtual Machine Library, and select "Open Config File in Editor"  The contents of the config file (.vmx file) will be opened in the Mac's TextEdit app.
Procedure continues on the next page	

**Procedure: Change Secure Boot on Fusion Player when the encryption setting is “All the files” (continued)**

3.	<p>Search for a line in the file starting with:</p> <pre>uefi.secureBoot.enabled =</pre> <p>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)</p> <pre>uefi.secureBoot.enabled = "FALSE"</pre>
4.	<p>To enable Secure Boot, change the line to read:</p> <pre>uefi.secureBoot.enabled = "TRUE"</pre> <p>To disable Secure Boot, change the line to read:</p> <pre>uefi.secureBoot.enabled = "FALSE"</pre>
5.	<p>Save the file and exit the TextEdit app.</p>

You may now restart your VM.

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

**Warnings:**

Shut down (do not suspend) the virtual machine, shut down Fusion, then make a backup copy of the entire VM bundle to another disk before using this procedure.

This procedure will decrypt then re-encrypt your VM. 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. If you enabled Bitlocker in the Windows 11 VM, do not start this procedure unless you verify that you have the Bitlocker recovery key. 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>

Procedure: Change Secure Boot on Fusion Player when the VM is encrypted with “All the files”	
1.	Start the VMware Fusion application. Make sure the VM is shut down (not suspended) and that no Settings window for the VM is open.
2.	Open the VM's Settings.
3.	Click on <b>“Trusted Platform Module”</b> and then click the <b>“Remove Trusted Platform Module”</b> button that appears. Confirm that you want the device removed.
4.	Click the <b>“Show All”</b> button at the top of the window, then click on <b>“Encryption”</b> . In the panel that appears, the current encryption state of the VM should be displayed. Select <b>“The virtual machine is not encrypted”</b> 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..	Option-right click on the VM’s name in the Virtual Machine Library, and select <b>“Open Config File in Editor”</b> 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: <pre>uefi.secureBoot.enabled =</pre> 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.): <pre>uefi.secureBoot.enabled = "FALSE"</pre>
9.	To enable Secure Boot, change the line to read: <pre>uefi.secureBoot.enabled = "TRUE"</pre> To disable Secure Boot, change the line to read: <pre>uefi.secureBoot.enabled = "FALSE"</pre>
Procedure continues on the next page	



Procedure: Change Secure Boot on Fusion Player when the encryption setting is “All the files” (continued)	
10.	Save the file and exit the TextEdit app.
11.	Open the VM’s Settings.
12.	Re-encrypt the VM. This is required to support the TPM device that Windows 11 needs. Click on <b>“Encryption”</b> and select the desired type of encryption to apply to the VM. It is recommended to choose <b>“Only the files needed to support a TPM”</b> . Choose a password and opt to save it in the Mac’s Keychain.
13.	Wait for the VM to re-encrypt itself (if you chose <b>“All the files”</b> it will take a while, so be patient).
14.	Click <b>“Show All”</b> to return to the main Settings page.
15.	Click the <b>“Add Device”</b> button in the upper right-hand corner. A list of devices will appear.
16.	Click on <b>“Trusted Platform Module”</b> , then click <b>“Add”</b> .
17.	Close the VM’s Settings.

You may now restart your VM. If you had Bitlocker enabled in the VM before starting this procedure, Windows may ask you for the Bitlocker recovery key to restore access to your VM. Provide the Recovery Key that you located before starting the procedure.

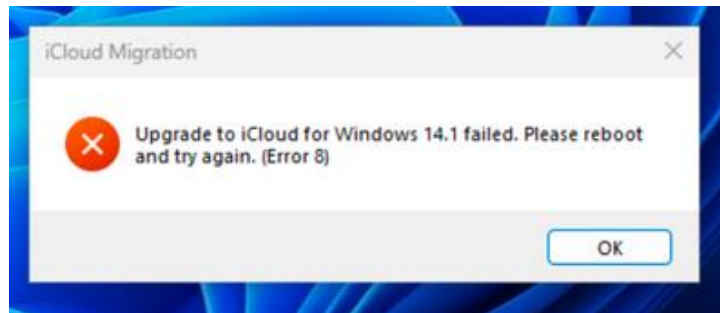
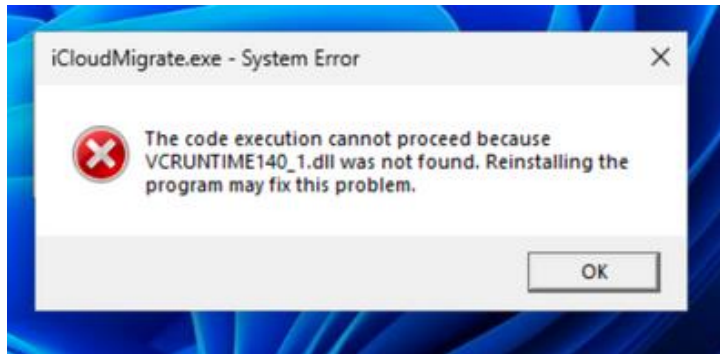
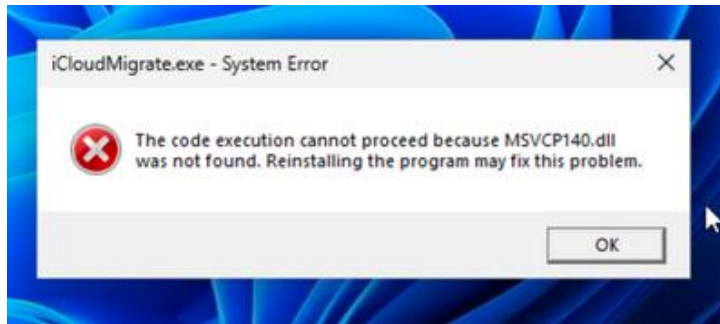
### Verifying Secure Boot settings in a Windows 11 VM

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>

### 13.11. iCloud app fails to install from the Microsoft Store

Thanks to Dan Mahoney (@AFerrit) for reporting this.

Installing the iCloud app from the Microsoft store in a Windows 11 ARM VM may fail with the following messages being displayed:



These errors occur because the iTunes App requires components from the Microsoft Visual C++ Redistributable. By default, this software is not installed on Windows 11 ARM. The iTunes app does not install this software for you. No checking appears to be done by either the Microsoft Store or the iTunes app installer for the existence of the C++ runtimes before the installation is performed, so the installation fails.

To fix this error, download the installer for the Visual C++ Redistributable package for ARM64 from Microsoft at [https://aka.ms/vs/17/release/vc\\_redist.arm64.exe](https://aka.ms/vs/17/release/vc_redist.arm64.exe) (permalink to the latest version) and install it. Then reinstall the iCloud app from the Microsoft Store.

Other software may exhibit similar issues if the Visual C++ Redistributable is not installed on your system.

## Appendix A. Glossary

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<b>Apple Silicon</b>	<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>
<b>ARM</b>	<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>
<b>arm64/aarch64</b>	<p>Refers to the 64-bit ARM CPU architecture or instruction set. Incompatible with x86 or x64/x86_64 architectures.</p>
<b>Blacklisting a driver</b>	<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>
<b>Bridged networking</b>	<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 <b>‘NAT networking’</b>.</p>
<b>Emulation</b>	<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 <b>‘Virtualization’</b>.</p>
<b>ESXi</b>	<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>

<b>EULA</b>	Shorthand for <b>End User License Agreement</b> . 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.
<b>GRUB</b>	<p>Software that manages the early stages of the boot process for a Linux operating system. It is a de-facto standard for almost all Linux operating systems.</p> <p>GRUB is shorthand for ‘<b>GR</b>and <b>U</b>nified <b>B</b>ootloader’ in case you were wondering.</p>
<b>Guest</b>	<p>A virtual machine that runs under the control of a hypervisor.</p> <p>See ‘<b>Host</b>’.</p>
<b>Homebrew</b>	A software package manager obtained from <a href="https://brew.sh">https://brew.sh</a> that allows the installation of many popular Linux open-source programs and utilities on the Mac.
<b>Host</b>	<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>See ‘<b>Guest</b>’.</p>
<b>Hypervisor</b>	<p>From Wikipedia: <a href="https://en.wikipedia.org/wiki/Hypervisor">https://en.wikipedia.org/wiki/Hypervisor</a></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>
<b>ISO</b>	<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>
<b>KB article</b>	Shorthand for “Knowledge Base” article or tech note.

<b>Kernel</b>	<p>From Wikipedia:</p> <p><a href="https://en.wikipedia.org/wiki/Kernel_(operating_system)">https://en.wikipedia.org/wiki/Kernel_(operating_system)</a>:</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>
<b>M1 and M2</b>	<p>Apple Silicon CPU chips used by Apple in Macs beginning in late 2020. The original M1, M1 Max, M1 Pro, M1 Ultra, and M2 are the current Apple 'M series' CPUs.</p>
<b>MacPorts</b>	<p>A software package manager obtained from <a href="https://macports.org">https://macports.org</a> that allows the installation of many popular Linux open-source programs and utilities on the Mac.</p>
<b>NAT networking</b>	<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>
<b>Nested virtualization</b>	<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>

<b>open-vm-tools</b>	<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>
<b>.ova/.ovf</b>	<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>
<b>Virtualization</b>	<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 ‘<b>Emulation</b>’.</p>
<b>VM</b>	<p>Shorthand for virtual machine or guest.</p>
<b>VHDX file</b>	<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 ‘<b>VMDK file</b>’.</p>
<b>VMDK file</b>	<p>The file format used by VMware Fusion for its virtual disk files.</p> <p>Compare with ‘<b>VHDX file</b>’.</p>
<b>VMware SVGA 3D</b>	<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>
<b>VMware Tools</b>	<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>
<b>vmwgfx</b>	<p>The Linux kernel device driver that provides support for the VMware SVGA 3D virtual graphics adapter.</p> <p>See ‘VMWare SVGA 3D’</p>

<b>Windows 11 ARM</b>	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
<b>x64/x86_64</b>	Refers to the 64-bit Intel or AMD CPU architecture or instruction set. Incompatible with arm64/aarch64 architectures.
<b>x86</b>	Refers to the 32-bit Intel or AMD CPU architecture or instruction set. Incompatible with arm64/aarch64 architectures.

## Appendix B. Archived Topics

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The topics in this section contain workarounds for issues that were reported in older versions of Linux operating systems. The issues have been fixed in current Linux operating system releases. These topics are archived here in case you are running an older Linux operating system that is impacted by these issues.

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

This issue is fixed in RHEL 9.1.

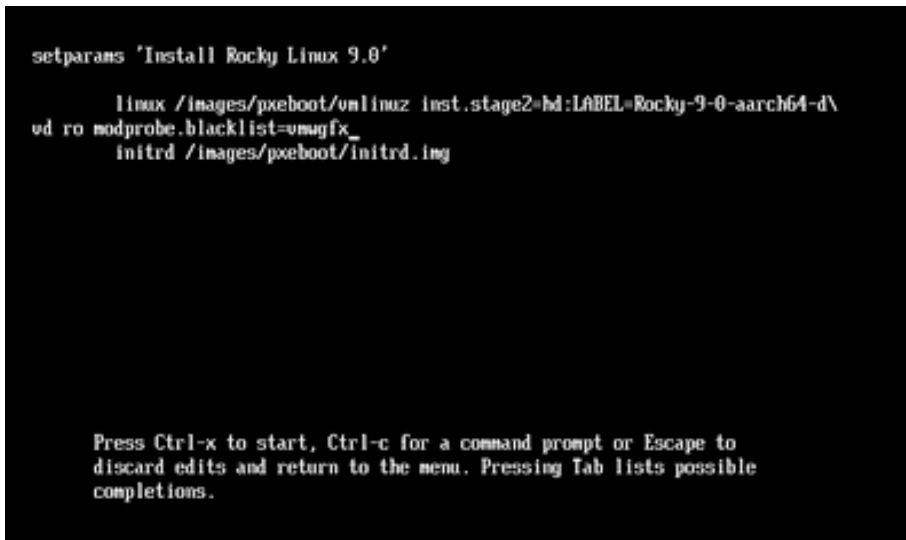
RHEL 9.0 installation ISOs will fail to boot on Fusion 13. The symptom is that the VM's console goes blank with a blinking cursor at the upper left corner of the window.

The cause of this behavior is described in the topic [Some arm64 Linux kernels do not boot on Fusion 13](#). This issue does not exist with RHEL 9.1.

To boot RHEL9.0 installers, follow the procedure in the topic above to disable the `vmwgfx` driver from being loaded by using the following kernel argument:

```
modprobe.blacklist=vmwgfx
```

The resulting GRUB command should look something like this:



```
setparams 'Install Rocky Linux 9.0'

linux /images/pxeboot/vmlinuz inst.stage2=hd:LABEL=Rocky-9-0-aarch64-dv
vd ro modprobe.blacklist=vmwgfx
initrd /images/pxeboot/initrd.img

Press Ctrl-x to start, Ctrl-c for a command prompt or Escape to
discard edits and return to the menu. Pressing Tab lists possible
completions.
```

Press “**ctrl-x**” to boot the installer using these arguments.

The disabling will persist into the virtual machine. The driver can be re-enabled for use after upgrade to RHEL 9.1 by commenting out the line containing “`blacklist vmwgfx`” from the file `/etc/modprobe.d/anaconda-blacklist.conf`.



## 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. ISO installers for RHEL 9.1 and current releases of CentOS 9 Stream fix this issue.

When booting into the text mode installer, the installer OS appears to boot but the console screen remains blank.

To work around this, edit the GRUB boot entry for text mode installation and add “**console=tty0**” to the kernel boot parameters.

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

This issue is fixed in RHEL 9.1.

(Thanks to @k\_ronny for the inspiration for this work-around).

Using the procedure in the topic [RHEL 9.0 Installation ISOs will not boot](#) results in the installer persisting the disabling of vmwgfx into the installed VM. This results in a graphical display whose resolution cannot be changed from the defaults of 1024x768.

The disabling of vmwgfx cannot be removed for RHEL 9.0 because the kernels do not allow proper operation of the vmwgfx driver.

Until the VM is upgraded to RHEL 9.1, the following workaround can be used to provide a larger screen resolution. While the screen resolution is larger with this workaround, it is still static and cannot be dynamically resized.

Procedure: Changing the static graphics resolution of a RHEL 9.0 VM	
1.	Boot the VM, log in, open a Terminal session and sudo to root.
2.	Open the file <code>/etc/default/grub</code> in your favorite text editor.
3.	Add the following line to the top of the file to set the graphics resolution to 1920x1200. <code>GRUB_GFXMODE=1920x1200</code>
4.	Find the following line in the file <code>GRUB_TERMINAL_OUTPUT="console"</code> and change it to: <code>GRUB_TERMINAL_OUTPUT="gfxterm"</code>
5.	Save the changes and exit the editor.
Procedure continues on the next page	

Procedure: Changing the static graphics resolution of a RHEL 9.0 VM (continued)	
6.	Upgrade the GRUB menus by executing the following command: <code># grub2-mkconfig --output /boot/grub2/grub.cfg</code>
7.	Reboot the virtual machine. Graphics resolution will now be set to 1920x1200.

This workaround and any vmwgfx disabling can be removed once the VM is upgraded to RHEL 9.1.

#### B.4. FIXED: Kali 2022.2 VM fails to boot after initial installation

After a fresh installation of Kali from the 2022.2 ISO, the VM displays a blank screen after a successful installation. The 5.16 kernel installed by the Kali Linux 2022.2 ISO contains a VMware SVGA (vmwgfx) driver that is incompatible with Fusion 13.

This issue is fixed by updating to or installing Kali 2022.3 or later.

A freshly installed Kali 2022.2 installation can be booted by temporarily disabling the use of the vmwgfx driver using the following procedure. At that point, Kali can be updated to obtain a newer kernel that eliminates the need for this procedure in the future.

Procedure: Fixing Kali 2022.2 initial installations from ISO media	
1.	Power on the VM.
2.	At the GRUB menu, highlight the Kali Linux entry and press 'e' to edit the boot commands.
3.	Add the following kernel argument to prevent the vmwgfx driver from loading <code>module_blacklist=vmwgfx</code>
4.	Press “Ctrl-x”. The VM should now boot, and the graphical session login will appear.
5.	Log into the VM, open the Terminal application, and sudo to root.
(Procedure continues on the next page)	

Procedure: Fixing Kali 2022.2 initial installations from ISO media (continued)	
6.	<p>From the Terminal session, update the Kali Linux installation.</p> <pre># apt update # apt full-upgrade -y</pre> <p>The package updates will include an update to the kernel to version 5.18.5 or later that fixes the issue.</p>
7.	<p>After the updates have finished installing, reboot the VM. The VM should start normally without need for this procedure.</p>

## B.5. Installing Fedora 36 from ISO

Installation from Fedora 36 ISOs may hang at the boot screen. Follow this procedure to install both releases from ISO if this occurs.

Procedure: Installing Fedora 36 from ISO	
1.	Create the virtual machine as you normally would from ISO installation media.
2.	Power on the virtual machine and disable the vmwgfx video driver from loading using the procedure in the topic <a href="#">Some arm64 Linux installers do not boot on Fusion 13</a> . This blocks the VMware driver, allows the installer to boot, and persists the block into the Fedora installation on the virtual machine's hard drive.
3.	The Fedora live environment will now become active. Install Fedora to the virtual hard drive from this environment.
4.	When the installation finishes, shut down the VM and use the Fusion GUI to take a snapshot. This snapshot will be useful if something does not work properly during the execution of steps 5 through 10.
5.	Restart the virtual machine. The virtual machine's console will be set to a fixed 1024x768 resolution and cannot be changed at this time.
6.	Log in, execute Terminal, and sudo to a root shell.
<p>Procedure continues on the next page</p>	

Procedure: Installing Fedora 36 from ISO (continued)	
7.	<p>Issue the following command:</p> <pre># dnf list 'grubby*'</pre> <p>If this command shows that both the “grubby” and “grubby-deprecated” packages are installed, software updates will fail with a file conflict. One of these two packages must be removed to allow software updates to install. Choose one (and only one) of the following options:</p> <p><b>Option 1: (Recommended)</b> Remove the “grubby-deprecated” package using the following two commands</p> <pre># dnf remove grubby-deprecated # grub2-switch-to-blscfg</pre> <p><b>Option 2:</b> Remove the “grubby” package with the following command:</p> <pre># dnf remove grubby</pre>
8.	<p>Perform a software update to obtain the latest Fedora packages. Since a root shell is already active, use the command line version:</p> <pre># dnf upgrade</pre> <p>This process will install an updated kernel that will allow changing of the screen resolution.</p> <p>Do not reboot yet.</p>
9.	<p>Remove the blocking of the vmwgfx driver that the Fedora installer persisted into the virtual machine. Open the file <code>/etc/modprobe.d/anaconda-denylist.conf</code> in your favorite text editor and find the line that reads:</p> <pre>blacklist vmwgfx</pre> <p>Comment out the line. The line should now read:</p> <pre># blacklist vmwgfx</pre> <p>Save your changes and exit the editor.</p>
10.	<p>Reboot the virtual machine and verify screen resolution can be changed.</p> <p>If the reboot is successful, delete the snapshot taken in step 4.</p>