

Linux Integration Services 4.1

Microsoft Corporation

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Abstract

The Linux Integration Services package updates Linux Hyper-V drivers in applicable Linux distributions to the latest available, ensuring the best performance and fullest use of Hyper-V features.



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Linux Integration Services 4.1

Supported Virtualization Server Operating Systems

Linux Integration Services (LIS) 4.1 allows Linux guests to use Hyper-V virtualization on the following host operating systems:

- Windows Server 2008 R2 (applicable editions)
- Microsoft Hyper-V Server 2008 R2
- Windows 8 Pro and 8.1 Pro
- Windows Server 2012 and 2012 R2
- Microsoft Hyper-V Server 2012 and 2012 R2
- Windows Server 2016
- Microsoft Hyper-V Server 2016
- Microsoft Azure

Applicable Linux Distributions

Microsoft provides Linux Integration Services for a broad range of Linux distros as documented in the [Linux and FreeBSD Virtual Machines on Hyper-V](#) topic on TechNet. Per that documentation, many Linux distributions and versions have Linux Integration Services built-in and do not require installation of this separate LIS package from Microsoft. This LIS package is available for a subset of supported distributions in order to provide the best performance and fullest use of Hyper-V features. It can be installed in the listed distribution versions that do not already have LIS built in, and can be installed as an upgrade in listed distribution versions that already have LIS built-in.

The built-in Red Hat Enterprise Linux Integration Services drivers for Hyper-V (available since Red Hat Enterprise Linux 6.4) are sufficient for Red Hat Enterprise Linux guests to run using the high performance synthetic devices on Hyper-V hosts. These built-in drivers are certified by Red Hat for this use, and certified configurations can be viewed on the [Red Hat Customer Portal](#). It is not necessary to download and install this Linux Integration Services package from the Microsoft Download Center to use Red Hat Enterprise Linux on Hyper-V, and doing so may limit your Red Hat support as described in [Red Hat Knowledgebase article 1067](#).

LIS 4.1 is applicable to the following guest operating systems:

- Red Hat Enterprise Linux 5.2-5.11 32-bit, 32-bit PAE, and 64-bit
- Red Hat Enterprise Linux 6.0-6.8 32-bit and 64-bit

- Red Hat Enterprise Linux 7.0-7.2 64-bit
- CentOS 5.2-5.11 32-bit, 32-bit PAE, and 64-bit
- CentOS 6.0-6.8 32-bit and 64-bit
- CentOS 7.0-7.2 64-bit
- Oracle Linux 6.4-6.8 with Red Hat Compatible Kernel 32-bit and 64-bit
- Oracle Linux 7.0-7.2 with Red Hat Compatible Kernel 64-bit

Linux Integration Services 4.1 Feature Set

When installed on a virtual machine that is running a supported Linux distribution, LIS 4.1 for Hyper-V provides the additional functionality over LIS 4.0 listed in the table below.

- Now installable on Red Hat Enterprise Linux 5.2, 5.3, 5.4, 6.8, and 7.2
- Now installable on CentOS 5.2, 5.3, 5.4, 6.8, and 7.2
- Now installable on Oracle Linux 6.8 and 7.2 when running the Red Hat Compatible Kernel
- Hyper-V Sockets
- Manual Memory Hot-Add and Remove
- SCSI WWN
- lsvmbus
- Uninstallation script

More details on individual features can be found at <http://technet.microsoft.com/en-us/library/dn531031.aspx>

Expanded Releases

This 4.1 series of Linux Integration Services has an expanded range of applicable releases.

- Red Hat Enterprise Linux and CentOS 5.2, 5.3, and 5.4
- Red Hat Enterprise Linux, CentOS, and Oracle Linux with Red Hat Compatible Kernel 7.2.
- Red Hat Enterprise Linux, CentOS, and Oracle Linux with Red Hat Compatible Kernel 6.8 was added with Linux Integration Services version 4.1.2.



Note:

Because the filesystem freeze feature is not available in Red Hat Enterprise Linux kernels before 5.5, VSS backup is not available on Red Hat Enterprise Linux or CentOS 5.2, 5.3, or 5.4.

Hyper-V Sockets

Starting with Technical Preview 4 of Windows Server 2016, an additional Host/Guest communications channel called Hyper-V Sockets is available. This feature is described in this TechNet note: https://msdn.microsoft.com/en-us/virtualization/hyperv_on_windows/develop/make_mgmt_service

An additional kernel module is required to use this feature, called hv_sock. On Red Hat Enterprise Linux, CentOS 6.0 or greater, or Oracle Linux with Red Hat Compatible Kernel 6.4 or greater, load the module hv_sock as root or with sudo:

```
# modprobe hv_sock
```

When loaded on Hyper-V hosts other than Windows Server 2016, loading this module will fail with an error similar to the following:

```
FATAL: Error inserting hv_sock (/lib/modules/2.6.32-358.el6.x86_64/extra/microsoft-hyper-v/hv_sock.ko): No such device
```

Manual Memory Hot Add and Remove

Starting with Technical Preview 4 of Windows Server 2016, memory on Linux Virtual Machines with LIS 4.1 can be increased via the Hyper-V Manager when the VM is configured without Dynamic Memory.

Memory allocated to the VM may be increased and decreased. The Linux Guest will not see a reduction in reported total memory as the decrease is handled similarly to dynamic memory and via the hv_balloon driver. It is recommended that memory be added or removed in multiples of 128 megabytes.

Due to limitations in kernel support for adding memory, this feature is not available in any releases before Red Hat Enterprise Linux or CentOS 6.5.

SCSI WWN

The storvsc driver now extracts WWN information from the port and node of attached devices and creates the appropriate sysfs files.

Isvmbus Tool

The python script Isvmbus has been added to /usr/sbin which can get information about devices on the Hyper-V vmbus, similar to information commands like lspci.

Uninstallation Script

Described below, Linux Integration Services 4.1 can be uninstalled to return the guest to the distribution-supplied kernel support for Linux on Hyper-V.

Installing Linux Integration Services 4.1

To install LIS components onto a Linux installation that has no Linux Integration Services installed, or has the built-in version of LIS, use the “install” method. The installation script will remove the distribution-supplied version of LIS and associated packages.

If a previous package of LIS has been installed—for example LIS 3.5 or 4.0—use the “upgrade” method in the next section. The upgrade script will automatically remove the superceded LIS packages and install new versions.

LIS is available in two formats, a tar file which can be transferred to a target virtual machine or an ISO file which can be attached to a virtual machine as a virtual DVD.

▶ To install Linux Integration Services 4.1 from the tar file:

1. Connect to the target virtual machine and verify that the running kernel is the latest installed kernel.
2. Transfer the `lis-rpms-4.1.2.tar.gz` file to the target virtual machine.
3. Extract the archived directory of files

```
# tar xvzf lis-rpms-4.1.2.tar.gz
```

4. Change to the `lis4` directory

```
# cd LISISO
```

5. Execute the installation script (there will not be any user prompts) as root or with `sudo`:

```
# ./install.sh
```

6. Restart the virtual machine.

```
# reboot
```

▶ To install Linux Integration Services 4.1 from the ISO file:

1. Connect to the target virtual machine and verify that the running kernel is the latest installed kernel.
2. In Hyper-V Manager, attach the `LinuxIC-4-1-2.iso` ISO to the virtual machine as a virtual DVD drive.
3. Some kernels may be missing the necessary driver to mount the virtual device. This can be corrected by loading the appropriate module as root or with `sudo`:

```
# insmod /lib/modules/$(uname -r)/kernel/drivers/ata/ata_piix.ko
```

4. Mount the virtual DVD as root or with sudo:

```
# mount /dev/cdrom /media
```

```
mount: /dev/sr0 is write-protected, mounting read-only
```

5. Change to the CD-ROM root directory

```
# cd /media
```

6. Execute the installation script (there will not be any user prompts) as root or with sudo:

```
# ./install.sh
```

7. Restart the virtual machine.

```
# reboot
```

Upgrading to Linux Integration Services 4.1

▶ To upgrade to LIS 4.1 from a previous LIS release with tar file:

1. Connect to the target virtual machine and verify that the running kernel is the latest installed kernel.
2. Transfer the lis-rpms-4.1.2.tar.gz file to the target virtual machine.
3. Extract the archived directory of files

```
# tar xvzf lis-rpms-4.1.2.tar.gz
```

4. Change to the lis4 directory

```
# cd LISISO
```

5. Execute the upgrade script (there will not be any user prompts) as root or with sudo:

```
# ./upgrade.sh
```

6. Restart the virtual machine.

```
# reboot
```

Sometimes when upgrading from a previous LIS version a message similar to “warning: %postun(microsoft-hyper-v-4.0.7-20150417.x86_64) scriptlet failed, exit status 6” may appear. These warnings can be ignored.

▶ To upgrade Linux Integration Services 4.1 from the ISO file:

1. Connect to the target virtual machine and verify that the running kernel is the latest installed kernel.

2. In Hyper-V Manager, attach the LinuxIC-4-1-2.iso ISO to the virtual machine as a virtual DVD drive.

3. Some kernels may be missing the necessary driver to mount the virtual device. This can be corrected by loading the appropriate module as root or with sudo:

```
# insmod /lib/modules/$(uname -r)/kernel/drivers/ata/ata_piix.ko
```

4. Mount the virtual DVD as root or with sudo:

```
# mount /dev/cdrom /media  
  
mount: /dev/sr0 is write-protected, mounting read-only
```

5. Change to the CD-ROM root directory

```
# cd /media
```

6. Execute the upgrade script (there will not be any user prompts) as root or with sudo:

```
# ./upgrade.sh
```

7. Restart the virtual machine.

```
# reboot
```

Sometimes when upgrading from a previous LIS version a message similar to “warning: %postun(microsoft-hyper-v-4.0.7-20150417.x86_64) scriptlet failed, exit status 6” may appear. These warnings can be ignored.

Uninstalling Linux Integration Services 4.1

The downloaded Linux Integration Services can be uninstalled to return to the built-in version available in the distribution kernel. This is recommended before a kernel upgrade or to return to a certified configuration.

Some versions of Red Hat Enterprise Linux, CentOS, or Oracle Linux with the Red Hat Compatible Kernel may require additional steps for uninstallation, such as modifying boot parameters in grub, which will be indicated by the uninstallation script.

▶ To uninstall LIS 4.1 with the tar file:

1. Connect to the target virtual machine.
2. Transfer the lis-rpms-4.1.2.tar.gz file to the target virtual machine.
3. Extract the archived directory of files

```
# tar xvzf lis-rpms-4.1.2.tar.gz
```

4. Change to the lis4 directory

```
# cd LISISO
```

5. Execute the uninstall script (there will not be any user prompts) as root or with sudo:

```
# ./uninstall.sh
```

6. If the Hyper-V daemons for KVP, VSS, and FCOPY are needed, reinstall the package “hyperv-daemons”:

```
# yum install hyperv-daemons
```

7. Restart the virtual machine.

```
# reboot
```

▶ To uninstall Linux Integration Services 4.1 with the ISO file:

1. Connect to the target virtual machine.
2. In Hyper-V Manager, attach the LinuxIC-4-1-2.iso ISO to the virtual machine as a virtual DVD drive.
3. Some kernels may be missing the necessary driver to mount the virtual device. This can be corrected by loading the appropriate module as root or with sudo:

```
# insmod /lib/modules/$(uname -r)/kernel/drivers/ata/ata_piix.ko
```

4. Mount the virtual DVD as root or with sudo:

```
# mount /dev/cdrom /media
```

```
mount: /dev/sr0 is write-protected, mounting read-only
```

5. Change to the CD-ROM root directory

```
# cd /media
```

6. Execute the uninstallation script (there will not be any user prompts) as root or with sudo:

```
# ./uninstall.sh
```

7. If the Hyper-V daemons for KVP, VSS, and FCOPY are needed, reinstall the package “hyperv-daemons”:

```
# yum install hyperv-daemons
```

8. Restart the virtual machine.

```
# reboot
```

Verifying Linux Integration Services 4.1 Functionality

Linux Integration Services kernel modules can be listed with the **modinfo** command. To get module information for each installed kernel module, run the following command and note the returned “version” information:

```
# /sbin/modinfo hv_vmbus

filename:      /lib/modules/2.6.32-71.el6.x86_64/extra/microsoft-hyper-
v/hv_vmbus.ko
version:      4.1.2
license:      GPL
srcversion:   63AD0529F69F51AEA8979B9
alias:        acpi*:VMBus:*
alias:        acpi*:VMBUS:*
depends:
vermagic:    2.6.32-71.el6.x86_64 SMP mod_unload modversions
```

Filename, srcversion, and vermagic will vary depending on the Linux distribution release and kernel version. This command can be repeated for all kernel modules (hv_vmbus, hv_netvsc, hv_storvsc, hv_blkvsc, and hv_utils).

To verify that all subcomponents are running in the kernel, execute the following command:

```
# /sbin/lsmmod | egrep -i "^hv|hyperv"
```

The output should include lines similar to the following:

```
hv_balloon          11908  0 [permanent]
hv_utils            15089  2
hyperv_keyboard     2600   0
hid_hyperv          3518   0
hv_storvsc          11942  2
hyperv_fb           8097   1
hv_vmbus            37961  7
hv_netvsc,hv_balloon,hv_utils,hyperv_keyboard,hid_hyperv,hv_storvsc,hyperv_fb
```

**Note**

Your file system type or other local factors might result in different file sizes in your deployment.

Also, the script “lsvmbus” has been added to /sbin and can be used to look at vmbus devices:

```
$ /sbin/lsvmbus

VMBUS ID 1: [Dynamic Memory]
VMBUS ID 2: Synthetic IDE Controller
VMBUS ID 3: [Reserved system device]
VMBUS ID 4: Synthetic mouse
VMBUS ID 5: Synthetic keyboard
VMBUS ID 6: Synthetic framebuffer adapter
VMBUS ID 7: [Reserved system device]
VMBUS ID 8: [Guest services]
VMBUS ID 9: [Heartbeat]
VMBUS ID 10: [Data Exchange]
VMBUS ID 11: [Operating system shutdown]
VMBUS ID 12: [Time Synchronization]
VMBUS ID 13: [Backup (volume checkpoint)]
VMBUS ID 14: [Reserved system device]
VMBUS ID 15: Synthetic network adapter
VMBUS ID 16: Synthetic SCSI Controller
```

Source Code for Linux Integration Services

GitHub repository for LIS 4.1. To access the latest source code for Linux Integration Services visit the “lis-next” public github repository at <https://github.com/LIS/lis-next/>

Known Issues

RPM Versions Specific to Kernel Versions

The kernel modules packaged as RPMs are built against specific kernel versions and can cause a kernel panic if applied to incorrect kernels. RPM rules have been applied to prevent an installation that will fail to boot.

The Linux Integration Services installer will apply the included modules against the latest kernel present, and require that kernel to be running. If a new kernel has been installed without rebooting, which can occur after a “yum update”, the Linux Integration Services installer will fail installation with a message similar to the following: “Your running kernel x is not your latest installed kernel, aborting installation.”

If a kernel updated without uninstalling Linux Integration Services, it will use built-in support. To install Linux Integration Services 4.1 on this newly installed kernel, the uninstallation process must be performed to remove the modules that were applied to the older kernel. Once removed, the installation process can install the modules on the latest kernel.

SELinux Policy Needed for Hyper-V Daemons

During the installation of Linux Integration Services 4.1 the Hyper-V daemons are installed in different device files. The default SELinux policies accept these new device files and will operate without needing intervention. On Red Hat Enterprise Linux, CentOS, and Oracle Linux with the Red Hat Compatible Kernel versions 6.6, 6.7, 6.8, 7.1, and 7.2 SELinux Policy can prevent the daemons for KVP and VSS from operating.

The following sample policy can be used to allow these daemons to operate if SELinux policies have restricted the Hyper-V daemons:

```
module hyperv-daemons 1.0;

require {
    type hypervkvp_t;
    type device_t;
    type hypervvssd_t;
    class chr_file { read write open };
}
```

```
allow hypervkvp_t device_t:chr_file { read write open };
allow hypervvssd_t device_t:chr_file { read write open };
allow ifconfig_t device_t:chr_file { read write open };
```

Put this policy in `hyperv-daemons.te` and compile it with the following command or with `sudo`:

```
# make -f /usr/share/selinux/devel/Makefile hyperv-daemons.pp
```

To test the module and not have it loaded automatically on boot:

```
# semodule -i hyperv-daemons.pp
```

Then, to add the modules to the SELinux “Targeted” policy and automatically load it on future boots:

```
# semodule -s targeted -i hyperv-daemons.pp
```

If the SELinux policy is installed at the same time as installation of Linux Integration Services 4.1, a message may be seen that the device files `/dev/vmbus/hv_kvp` or `/dev/vmbus/hv_vss` do not exist. These device files will not be created until the system is rebooted after installation of Linux Integration Services 4.1 and this message can be ignored.

Installation Warnings

Older kernels should be removed if not needed on guest virtual machines. If kernels with different Application Binary Interfaces are present on the system during Linux Integration Services installation, messages similar to the following can be observed:

```
depmod: WARNING: /lib/modules/3.10.0-229.el7.x86_64/weak-updates/microsoft-
hyper-v/hv_sock.ko needs unknown symbol vmbus_send_tl_connect_request
depmod: WARNING: /lib/modules/3.10.0-229.el7.x86_64/weak-updates/microsoft-
hyper-v/hv_sock.ko needs unknown symbol vmbus_set_hvsock_event_callback
depmod: WARNING: /lib/modules/3.10.0-229.el7.x86_64/weak-updates/microsoft-
hyper-v/hv_sock.ko needs unknown symbol vmbus_recvpacket_hvsock
depmod: WARNING: /lib/modules/3.10.0-229.el7.x86_64/weak-updates/microsoft-
hyper-v/hv_sock.ko needs unknown symbol vmbus_get_hvsock_rw_status
depmod: WARNING: /lib/modules/3.10.0-229.el7.x86_64/weak-updates/microsoft-
hyper-v/hv_sock.ko needs unknown symbol vmbus_sendpacket_hvsock
depmod: WARNING: /lib/modules/3.10.0-229.el7.x86_64/weak-updates/microsoft-
hyper-v/hv_sock.ko needs unknown symbol vmbus_hvsock_device_unregister
```

```
depmod: WARNING: /lib/modules/3.10.0-229.el7.x86_64/weak-updates/microsoft-  
hyper-v/hyperv_fb.ko needs unknown symbol vmbus_allocate_mmio
```

These warnings are benign and can be ignored.

Hangs Requesting Additional Dynamic Memory After Startup

When using Dynamic Memory, Red Hat Enterprise Linux, CentOS, and Oracle Linux with the Red Hat Compatible Kernel 6.0-6.7 if memory usage quickly increases beyond startup the kernel may become unresponsive. The guest OS will have run out of memory before setting up the process to request more memory from the host.

Timeout Hot Adding Memory on 6.5 to 6.8

On Red Hat Enterprise Linux, CentOS, and Oracle Linux with the Red Hat Compatible Kernel additional time may be required to hot add memory before increasing the value again. Best practice is to add memory in multiples of 128MB and to wait at least ten seconds before changing the value again.

More Memory Needed for Crash Dumps

The amount of memory needed for kdump defaults to “auto” but on some configurations this amount may need to be increased to “crashkernel=384” or “crashkernel=512” on SMP systems. Larger values for this kernel parameter will consume more memory than the “auto” setting.

Additional Information About Linux Integration Services

Review “Best Practices for running Linux on Hyper-V” at <https://technet.microsoft.com/en-us/library/dn720239.aspx> for more information on features, solutions, procedures, and workarounds.

Customers can provide feedback through the [Linux and FreeBSD Virtual Machines on Hyper-V forum](#). We look forward to hearing about your experiences with LIS.