Linux Integration Services 4.3.5

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.

Copyright Information

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Supported Virtualization Server Operating Systems

Linux Integration Services (LIS) 4.3.5 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 10 Pro

- Windows Server 2016

- Microsoft Hyper-V Server 2016

- Windows Server 2019

- Microsoft Hyper-V Server 2019

- 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 4.3.5 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 6.0-6.10 32-bit and 64-bit

- Red Hat Enterprise Linux 7.0-7.6 64-bit

- CentOS 5.2-5.11 32-bit, 32-bit PAE, and 64-bit

- CentOS 6.0-6.10 32-bit and 64-bit

- CentOS 7.0-7.6 64-bit

- Oracle Linux 6.4-6.10 with Red Hat Compatible Kernel 32-bit and 64-bit

- Oracle Linux 7.0-7.6 with Red Hat Compatible Kernel 64-bit

Linux Integration Services 4.3.5 Feature Set

When installed on a virtual machine that is running a supported Linux distribution, LIS 4.3.5 for Hyper-V provides the additional functionality over LIS 4.2 listed in the table below.

- SRIOV (for example, Azure Accelerated Networking) capability for Red Hat Enterprise Linux, CentOS, and Oracle Linux with the Red Hat Compatible Kernel versions 6.7-6.10 (64-bit only)

- Updated mlx4 and mlx5 drivers for Red Hat Enterprise Linux, CentOS, and Oracle Linux with the Red Hat Compatible Kernel versions 7.3-7.4.

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

SR-IOV in Azure

Red Hat Enterprise Linux and CentOS 6.7-6.10 Only.

LIS 4.3.5 includes updates that enable the PCI Passthrough driver for Hyper-V. However, these older releases do not include a virtual function driver for SRIOV on Hyper-V and the LIS

Download does not include these drivers for 6.7-6.10. These VF drivers must be installed first before installing the LIS Download.

For Azure Accelerated Networking, the recommended way to install the Mellanox VF drivers is to install Mellanox OFED version 4.5 or newer. The process to follow is:

1. Update to the latest kernel for your intended release.
2. Install Mellanox OFED 4.5.
3. Reboot from the updated kernel.
4. Install LIS 4.3.5.
5. Shut down the VM.
6. Enable SRIOV or Accelerated Networking on the intended NICs.
7. Reboot to use the updated modules and Accelerated Networking.

When any of the components above are updated or if the instructions are not followed in this order the Hyper-V device drivers will revert to the built-in version, and PCI Passthrough and SRIOV will not be available.

For information on enabling SR-IOV for your Azure virtual machines, refer to the Azure documentation at https://docs.microsoft.com/en-us/azure/virtual-network/virtual-network-accelerated-networking-portal

Red Hat Enterprise Linux and CentOS 7.3-7.4 Only.

LIS 4.3.5 includes updates to the PCI Passthrough driver for Hyper-V as well as including an updated version of the Mellanox mlx4 and mlx5 NIC device drivers. On Red Hat Enterprise Linux and CentOS 7.3 and 7.4 virtual machines in Azure with SR-IOV enabled, the Mellanox NIC will appear as a PCI device, and the appropriate driver will automatically load. The Mellanox driver is different than the one included in Red Hat Enterprise Linux 7.3 and 7.4, so using it may limit your Red Hat support as described in Red Hat Knowledgebase article 1067.

LIS 4.3.5 includes "Transparent SR-IOV" where the management of the Virtual Function (VF) device is handled by the synthetic network driver (netvsc). No manual bonding or configuration of the VF driver or device is required. It also installs a udev rule to prevent network-manager from managing the VF interface. If the bonding interface from LIS 4.2.2 is detected, the installer will remove that previous configuration.

For information on enabling SR-IOV for your Azure virtual machines, refer to the Azure documentation at https://docs.microsoft.com/en-us/azure/virtual-network/virtual-network-accelerated-networking-portal

The Linux Integration Services download is not required for SR-IOV in Azure for Red Hat Enterprise Linux or CentOS 7.5 or newer.

TimeSync PTP Service

Linux Integration Services uses the Hyper-V Timesync protocol to implement a Precision Time Protocol service with this time source. The Linux device will be of the form /dev/ptp*x*. To see all of the ptp clock sources available:

```
$ ls /sys/class/ptp
```

To verify the device is the TimeSync device, check the clock name:

```
$ cat /sys/class/ptp/ptpx/clock_name
hyperv
```

On Red Hat Enterprise Linux and CentOS 7.x, the Linux time tool chrony can be configured to use this clock as a source, which is disabled by default. ntpd doesn't support PTP sources, so using chronyd is recommended. To switch to the host clock when using chronyd, enable TimeSync as a source in /etc/chrony.conf:

```
refclock PHC /dev/ptp0 poll 3 dpoll -2 offset 0
```

If both NTP and TimeSync sources are enabled simultaneously, one could marked as "prefer" which sets the other source as a backup source.

On Red Hat Enterprise Linux and CentOS 6.x, PTP is not supported, so either NTP or TimeSync can be used as a time source. Enable TimeSync by disabling your NTP service, then running as root:

```
echo Y > /sys/module/hv_utils/parameters/timesync_mode
```

On Red Hat Enterprise Linux and CentOS 5.x, only the core Time Synchronization is available, where the hardware clock is synchronized on boot and shutdown.

Installing Linux Integration Services 4.3.5

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 download 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 4.3.5 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-4.3.5.tar.gz file to the target virtual machine.

3. Extract the archived directory of files

   ```
   # tar xvzf lis-rpms-4.3.5.tar.gz
   ```

4. Change to the LISISO 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 4.3.5 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-4.3.5.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 4.3.5

▶ **To upgrade to LIS 4.3.5 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-4.3.5.tar.gz file to the target virtual machine.

3. Extract the archived directory of files

```
# tar xvzf lis-rpms-4.3.5.tar.gz
```

4. Change to the LISISO 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 4.3.5 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-4.3.5.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 4.3.5

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 4.3.5 with the tar file:**

1. Connect to the target virtual machine.

2. Transfer the lis-rpms-4.3.5.tar.gz file to the target virtual machine.

3. Extract the archived directory of files

```
# tar xvzf lis-rpms-4.3.5.tar.gz
```

4. Change to the LISISO 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 4.3.5 with the ISO file:**

1. Connect to the target virtual machine.

2. In Hyper-V Manager, attach the LinuxIC-4.3.5.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 4.3.5 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:        4.3.5
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/lsmod | 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, on Red Hat Enterprise Linux 6, CentOS 6, or Oracle Linux 6.4 or newer, 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. 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 4.3.5 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 4.3.5 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 (as root 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 4.3.5, 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 4.3.5 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 after 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 with Runtime Memory Resize

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.

TimeSync Causes systemd to Log Repetitive Messages

On Red Hat Enterprise Linux and CentOS 6.x, the TimeSync integration service enhances the precision of time synchronization with the host. On Linux installations with systemd this can produce a large number of "systemd: Time has been changed" messages in /var/log/messages.

If TimeSync is not needed, uncheck the service from the Integration Services section of the settings for that virtual machine in Hyper-V Manager.

If TimeSync is desired, but the message is not, create a config file in rsyslog.d to filter out the messages:

1. Create a file in /etc/rsyslog.d, for example

```
# vi /etc/rsyslog.d/time_msgs.conf
```

2. Add this line:

```
:msg, contains, "Time has been changed" ~
```

3. Restart rsyslog to enable the change

```
# systemctl restart rsyslog.service
```

"hyperv_fb unable to send packet via vmbus"

Log messages indicating hyperv_fb is unable to send packets may be observed. Because hyperv_fb will retry, this message is just a warning and will be corrected in a future release.

"/sbin/weak-modules: line 174: /tmp/weak-modules.R6ac8m/old_initramfs/./usr/lib/modules/3.10.0-327.36.3.el7.x86_64/weak-updates/microsoft-hyper-v/hid-hyperv.ko: Permission denied"

This file conflict can be resolved by deleting the file /etc/modprobe.d/hyperv_pvdrivers.conf prior to upgrading.

Long delays removing VF (SRIOV) interfaces with Red Hat Enterprise Linux and CentOS 7.3

On Red Hat Enterprise Linux and CentOS 7.3 in Azure, if the virtual function driver is manually removed, there can be a long delay before the device is completely removed. This is a known issue that is corrected by Linux kernel changes in a later release of Red Hat Enterprise Linux and CentOS.

SR-IOV Performance with Red Hat Enterprise Linux and CentOS 7.5

On Red Hat Enterprise Linux and CentOS 7.5 there has been a regression in throughput on SRIOV interfaces in Azure with TCP and UDP. This is a known issue that will be corrected in a future release of Red Hat Enterprise Linux, CentOS, or the LIS download.

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.