



Backup and Recovery of KVM

Using Bacula Enterprise

This document is intended to provide insight into the considerations and processes required to backup KVM virtual machines controlled by libvirt.



Overview

This user's guide presents various techniques and strategies to backup KVM virtual machines with **Bacula Enterprise**. Bacula Enterprise is an especially secure, scalable and modular backup and recovery software solution with a wide range of capabilities. Backup up KVM hypervisor(s) and its data in a comprehensive manner is one of its many qualities. Bacula System's KVM Module is fast, reliable, especially simple to use and establishes confidence in the backup system administrator.

Features Summary

The **Bacula Enterprise** KVM plugin provides the following main features:

- Automatic virtual machine discovery
- File level backup of virtual machines
- Full, Differential, and Incremental backup level support
- The ability to handle inclusion/exclusion of files
- Backup of virtual machines in a “*running*”, “*paused*” or “*shut off*” state
- File level Restore of virtual machines - the possibility to restore a file from a KVM Virtual Machine without the need to restore the Full VM
- Single File Restore*
- Advanced security tools and techniques

Scope

This document will present solutions for Bacula Enterprise. Bacula Enterprise's KVM module is supported on Red Hat® Enterprise Linux®. The KVM plugin is designed to be used when the hypervisor uses local storage for virtual machine disks and libvirt for virtual machine management.

The current version of the KVM module is not compatible with:

- Proxmox
- Redhat RHEV or oVirt
- OpenStack

Bacula has separate specific high performance modules for Proxmox and RHV/oVirt. For more information on these, and Bacula's OpenStack module, please [contact Bacula Systems](#).



Glossary

KVM (Kernel-based Virtual Machine) is a full virtualization solution for Linux on x86 hardware containing virtualization extensions (Intel VT or AMD-V).

libvirt is a toolkit to interact with the virtualization capabilities of recent versions of Linux.

virsh is the libvirt command shell.

guestfish is a shell and command-line tool for examining and modifying virtual machine file-systems.

VM is an acronym for “*Virtual Machine*”.

1 What is KVM?

Kernel-based virtual machine (KVM) is an open source virtualization infrastructure built for Linux OS. It requires x86-based processor architecture to operate.

KVM consists of two technology components: kernel and user-space.

Kernel has two loadable modules: `kvm.ko`, and either `kvm-intel.ko` or `kvm-amd.ko`. The `kvm.ko` module is responsible for core architecture-independent virtualization processing. The latter two correspond to Intel and AMD processor-specific modules. These modules were merged into the Linux kernel as of version 2.6.20.

1.1 What are the advantages of KVM integration with the Linux kernel?

KVM enables Linux to do the system grunt work, so it can focus on handling new virtualization instructions exposed by the hardware. Another key benefit for KVM is that it inherits any continuing system improvement from upstream in the larger Linux community.

It is crucial that the kernel modules do not emulate the virtual machine hardware that the guest OS runs on. KVM uses QEMU to build the virtual machines (VM) that interact with guest OS. Each VM is a regular Linux process, which means familiar Linux commands like ‘top’ and ‘kill’ can be used to manage and monitor the VMs.

KVM transforms Linux into a type 1 hypervisor, also known as a bare-metal hypervisor. Type 1 hypervisors directly access the computer’s hardware and replace the host OS. They are also considered secure because there is nothing between a hypervisor and a CPU that a potential attacker could tamper with.

As part of the Linux kernel, KVM has all the OS-level components. This means that each VM works like a regular Linux process and has dedicated virtual components like memory, disks, CPU and network card.



1.2 KVM Backup – Common Approaches

To prevent data loss and facilitate system recovery in case the VM is compromised, it is crucial to back up KVM. A common backup strategy is to use a custom script like perl or something else. This type of script can be flexible and can be configured to suit the setup and backup needs of the VM. This process generally involves identifying the VM and for each VM, taking a snapshot of the disks. The snapshot is then dumped on a remote server or a backup storage.

Some scripts may require temporary suspension of the VM's operations. A risk to using scripts is that, while it is easy to access and execute, it can also open up VMs to security vulnerabilities.

Another way to use the snapshot tool is to install all the necessary components on the VM and use this as a base snapshot when it is time to restore.

A backup software may be installed on each VM, with a license required for each machine that will be backed up. The backup process itself can affect the performance of the VM on the server.

This module removes the need to have a client installed in each VM.

The module works at the Hypervisor Level, in the same way as Bacula's XEN and PROXMOX modules. The module is a fully integrated, agentless technology.

To back up, the user simply defines a file set.

However, in the instance of needing to restore a file to a running VM, the user would need to have a Bacula Enterprise client installed.

1.3 KVM Backup with Bacula Enterprise

Bacula Enterprise enables easy backup and restoration of KVMs at a file level. There is no software installation and scripting required for individual clients. Bacula Enterprise's high level of granularity allows users a high level of control over the data they need to (or don't need to) backup and recover. Auto-detection capabilities also enable automatic VM discovery, which means there is no need to define which VM to backup after initial configuration.

With Bacula Enterprise, it is possible to conduct KVM backup whether the VM is running, paused or shut off. Backing up VMs is a resource-intensive process that can reduce resource allocation to the OS, application files, user data and settings, and consequently, affect the performance of the VM. Bacula's backup tool enables KVM backup without service interruption and data consistency.

Snapshot backup is also available. When this is combined with Bacula Systems' patented Global Endpoint Deduplication engine and comm-line compression, users can save storage and reduce use of network bandwidth. Contact Bacula Systems for our dedicated whitepaper on Global Endpoint Deduplication.

1.4 File Level Restore of Virtual Machines

This module provides the capability of restoring a file from a KVM Virtual Machine without the need to restore the Full VM.

Backup of KVM virtual machines is possible in a 'running', 'paused' or 'shut off' state.



2 Restoring Files

Virtual machines are backed up at the file level. To restore a set of files to a virtual machine, a Bacula File Daemon must be installed inside the virtual machine. There is no need to stop or start a new virtual machine.

To restore a file with Bacula's KVM module, simply use the bconsole restore command, select the backup Job and run a traditional restore Job. This breaks down into three simple, rapid, steps:

- ① Check where in BEE which job contains my Backup
- ② Using BEE Bconsole or Bweb, select, job, files, and destination.
- ③ Run the restore.

The simplicity of this module can be of great benefit to a System Administrator. Imagine a scenario where we have a "hacked" server that is sending DDOS to the network, and the Sys Admin needs a file from it. She does not want to put her organization's network in danger or at risk by starting a VM to restore a file. Instead, she only selects the specific file to restore, without the need to restore the full VM.

2.1 Restoring to a Different Bacula Client

It is also possible to restore files to a different Bacula client and copy the files to the intended virtual machine afterward. Some of the advantages of being able to restore a single VM guest file instead the whole VM are:

- ① Saves Time, Network Bandwidth, and Hard Disk Space
- ② Security
- ③ Facilitates the Restore Workflow
- ④ Removes the need to stop or start a new virtual machine

2.2 Single File Restore

Single File Restore is possible with all VM guests where the "libguestfs" library is compatible. KVM and Bacula's KVM module use the library to access the guest's file system.

2.3 Restoring with BWeb

The images below demonstrates the sequence to recover KVM with Bacula's BWeb GUI interface



Client Selection → Restore Point Selection → 3 Files Selection → 4 Restore Options

Client: po-kvm-server-fd Backup Selected: Kvm Backup Restore Time Point: 2019-12-23 17:47:00

Step 3
To restore files and directories, drag and drop the selection to Restore Selection Area.

Backup Content

Path:	Name	Size	Date
/	home/	20 B	2019-12-23 16:38:40
	media/	6 B	2018-04-11 06:59:55
	mnt/	6 B	2018-04-11 06:59:55
	opt/	6 B	2018-04-11 06:59:55
	proc/	6 B	2019-12-23 16:29:39
	root/	114 B	2019-12-23 16:40:04
	run/	6 B	2019-12-23 16:29:40
	srv/	6 B	2018-04-11 06:59:55
	sys/	6 B	2019-12-23 16:29:40
	tmp/	211 B	2019-12-23 17:29:41
	usr/	155 B	2019-12-23 16:30:01
	var/	267 B	2019-12-23 17:29:07
	bin	7 B	2019-12-23 16:30:01

Limit: 0 - 500 Search in elements...

Version Browser
Here it is possible to choose between all versions of the current selected file, drag and drop selected version to the Restore Selection Area.

InChanger	Volume	Size	Date	Checksum
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Restore Selection Area
It is possible to drop files and directories here from the Backup Content list or from the Version Browser list above.

Name	JobId	Size	Date	Action
/etc/	15	8.0 KIB	2019-12-23 17:29:13	<input type="button" value="Drop"/>
/usr/	15	155 B	2019-12-23 16:30:01	<input type="button" value="Drop"/>

Bacula Enterprise Clients Jobs Media Storages Statistics Configuration Help Search...

Client Selection → Restore Point Selection → 3 Files Selection → 4 Restore Options

Client: po-kvm-server-fd Backup Selected: Kvm Backup Restore Time Point: 2019-12-23 17:47:00

Step 1
Select a Client.

Backup Client: po-kvm-server-fd

Step 2
Select backup to restore.

Advanced Filters
From Date: To Date: Job: all jobs Include Jobs in Error

JobId	Start Time	End Time	FileSet	Job Name
15	2019-12-23 17:40:25	2019-12-23 17:47:00	KVM	Kvm Back



Bacula Enterprise Clients Jobs Media Storages Statistics Configuration Help Search...

Client Selection → Restore Point Selection → Files Selection → 4 Restore Options

Client: po-kvm-server-fd Backup Selected: Kvm Backup Restore Time Point: 2019-12-23 17:47:00

Step 2
Select backup to restore.

Advanced Filters
From Date: [] To Date: [] Job: all jobs Limit: 300 JobId: 15

Apply Filter Include Jobs in Error

Search...

JobId	Start Time	End Time	FileSet	Job Name	Level	Job Files	Job Status	Select
15	2019-12-23 17:40:25	2019-12-23 17:47:00	KVM	Kvm Backup	F	30,618	✓	●

Step 3
To restore files and Restore Selection Area

Backup Content
Path: /

- home/
- media/
- mnt/
- opt/
- proc/
- root/
- run/
- srv/
- sys/
- tmp/
- usr/
- var/
- bin

Limit: 0 Search...
options ▾

← →

Bacula Enterprise Clients Jobs Media Storages Statistics Configuration Help Search...

Client Selection → Restore Point Selection → Files Selection → 4 Restore Options

Client: po-kvm-server-fd Backup Selected: Kvm Backup Restore Time Point: 2019-12-23 17:47:00

Step 3
To restore files and directories, drag and drop the selection to Restore Selection Area.

Version Browser
Here it is possible to choose between all versions of the current selected file, drag and drop selected version to the Restore Selection Area.

Backup Content
Path: /

Name	Size	Date
home/	20 B	2019-12-23 16:38:40
media/	6 B	2018-04-11 06:59:55
mnt/	6 B	2018-04-11 06:59:55
opt/	6 B	2018-04-11 06:59:55
proc/	6 B	2019-12-23 16:29:39
root/	114 B	2019-12-23 16:40:04
run/	6 B	2019-12-23 16:29:40
srv/	6 B	2018-04-11 06:59:55
sys/	6 B	2019-12-23 16:29:40
tmp/	211 B	2019-12-23 16:29:41
usr/	155 B	2019-12-23 16:30:01
var/	267 B	2019-12-23 17:29:07
bin	7 B	2019-12-23 16:30:01

InChanger Volume Size Date Checksum

Restore Selection Area
It is possible to drop files and directories here from the Backup Content list or from the Version Browser list above.

Name	JobId	Size	Date	Action
/etc/	15	8.0 KB	2019-12-23 17:29:13	✓
/usr/	15	155 B	2019-12-23 16:30:01	✓

Clear Selection Area Accept Files Selection

← →



Client Selection → Restore Point Selection → Files Selection → 4 Restore Options

Client: po-kvm-server-fd Backup Selected: Kvm Backup Restore Time Point: 2019-12-23 17:47:00

Step 4
Select advanced options for restore and plugins.

Restore Options Advanced Options kvm

Restore Options

Restore Client: po-kvm-server-fd
Where: /tmp/bacula-restores
Replace: Never
Comment:

Media Needed

InChanger Enabled Volume

 Re-compute media needed to restore (the action can take some time)

 Cancel  Run Restore

Bacula Enterprise Clients Jobs Media Storages Statistics Configuration Help Search...

Running job RestoreFiles.2019-12-23_17.49.15_10 on po-kvm-server-fd

Job Name:	RestoreFiles.2019-12-23_17.49.15_10 (16)
Processing File:	/tmp/bacula-restores/usr/bin/vi
Average Speed:	32,465,306 B/s
Current Speed:	32,465,306 B/s
Files Restored:	2,434
Files Expected:	27,054
Completed	8%
Bytes:	32,465,306

 Cancel

Job Report: RestoreFiles on po-kvm-server-fd (16)

Sel Order

```
2019-12-23 17:49:17 po-kvm-server-dir JobId 16: Start Restore Job RestoreFiles.2019-12-23_17.49.15_10
2019-12-23 17:49:17 po-kvm-server-dir JobId 16: Using Device "FileChgr1-Dev1" to read.
2019-12-23 17:49:17 po-kvm-server-sd JobId 16: Ready to read from volume "Vol-0001" on File device "FileChgr1-Dev1" (/tmp).
2019-12-23 17:49:17 po-kvm-server-sd JobId 16: Forward spacing Volume "Vol-0001" to addr=9033212
```

Bacula Enterprise is an especially high-security, flexible, feature-rich backup and recovery solution, enabling you to efficiently cover your entire IT environment from a single platform.

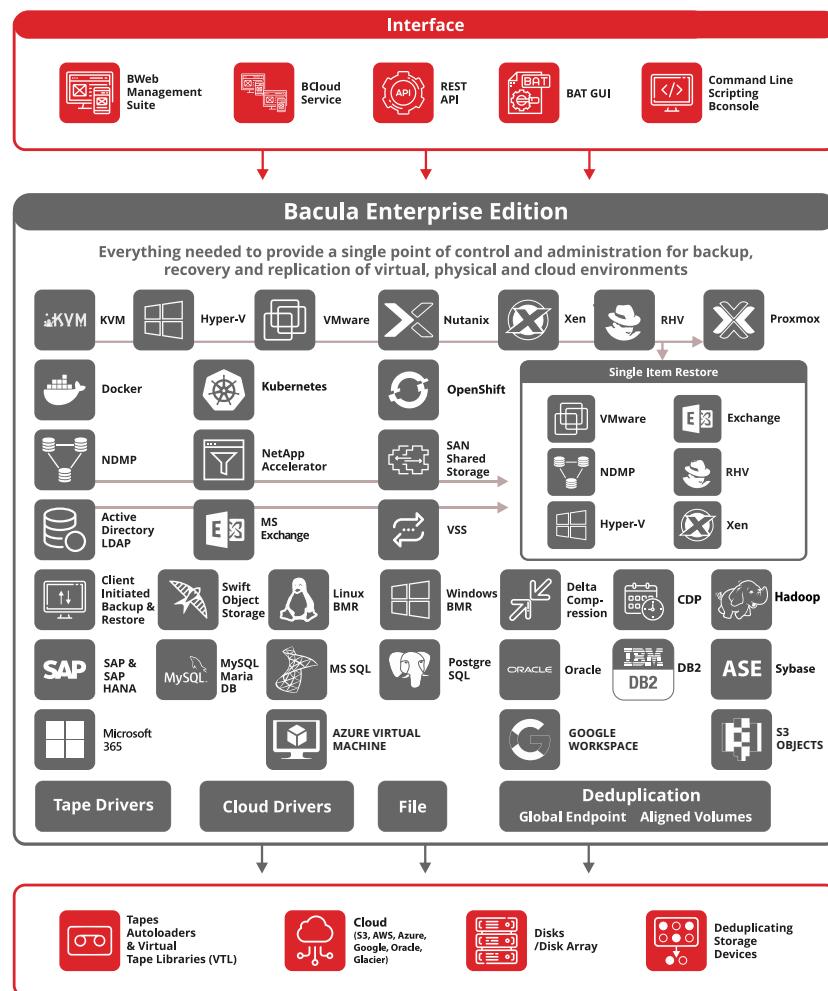


Figure 1: Bacula Enterprise Feature Set

3 Your IT Environment – Today and Tomorrow

The IT environment of many organizations today continues to get more complex as data is moved between on-premise, Cloud, virtual machines, containers and more. Not only must these organizations support multiple environments, but they are also seeing tremendous growth in the volume of data that they need to regularly manage. This introduces new backup and restore challenges for them to meet security compliance requirements, RTO's, RPO's and ever-tightening budgets.



As CIOs grapple with this, they usually discover that the traditional vendors they have been working with - who may have been fine in supporting IT as it used to be - are not architected to be able to cope with their wide variety of systems in an effective way. This usually becomes untenable when a new environment is brought to bear and suddenly the customer is told that there needs to be custom work or high contracting costs, or that it will not be supported until six to twelve months from now. This trigger often induces people to take a look at something they tend to not want to think about, which is backup and restore.

Bacula is a different type of company. We built our company with a modern, modular architecture that was designed using open principles for this new world of open volume. We also recognize that we felt the whole mind-set of the backup industry which was built around data volume, was going to be untenable in a world where data volumes are out of control. Our approach allows companies to support more environments much faster than they ever have before, with a lower-cost, fairer licensing model that is built around environments rather than volume.

Licensing model based on volume is a model that no longer works. Bacula's subscription model creates a more positive, constructive relationship between the backup vendor and the company – a relationship that is more suited for today's and tomorrow's world.

Bacula Enterprise data backup and recovery allows you to back up not only KVM environments, but covers your entire IT estate through a single pane of glass. It brings unprecedented levels of **security, business value benefits and low cost of ownership**. Contact Bacula now for a free trial.



For More Information

For more information on Bacula Enterprise, or any part of the broad Bacula Systems services portfolio, visit www.baculasystems.com.

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