Linux on System z

# Using the Dump Tools
# November, 2008

*Linux Kernel 2.6 - Development stream*

SC33-8412-01

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**Note**

Before using this information and the product it supports, read the information in “Notices” on page 37.

**Second Edition (November, 2008)**

This edition applies to Linux on System z Development stream, s390-tools version 1.8.0, and to all subsequent releases and modifications until otherwise indicated in new editions. This edition replaces SC33-8412-00.

SC33-8412 is the Linux on System z Development stream equivalent to SC33-8290, which applies to the Linux on System z October 2005 stream. For the April 2004 stream use SC33-8286.

# Contents

# Summary of changes

This revision reflects changes to the Development stream until November, 2008.

## Edition 2

This revision contains changes related to the November, 2008 software drop. This book applies to the Development stream. For the October 2005 stream see SC33-8290 and for the April 2004 stream see SC33-8286.

Changes compared to SC33-8412-00 are as follows:

***New Information***

- You can now create multi-volume dumps, see Chapter 3, “Using DASD devices for multi-volume dump,” on page 7.
- You can now use SCSI when creating a dump on z/VM (as of z/VM 5.4), see “Using SCSI” on page 21.

***Changed Information***

- The zgetdump command has been updated to accommodate multi-volume DASD dumps, see “The zgetdump tool” on page 29.

This revision also includes maintenance and editorial changes.

***Deleted Information***

- None.

## Edition 1

This revision contains changes related to the May, 2008 software drop. This book applies to the Development stream. For the October 2005 stream see SC33-8290 and for the April 2004 stream see SC33-8286.

Changes compared to SC33-8290-03 are as follows:

***New Information***

- The dumpconf tool now supports up to five CP commands that are executed in case of a kernel panic.

***Changed Information***

This revision also includes maintenance and editorial changes.

***Deleted Information***

- None.

# Chapter 1. Introduction

This document describes tools for obtaining dumps of Linux® on System z® instances.

You can use the dump analysis tool **lcrash** (from lkcdutils version 3.1.2 and higher) or **crash** (from version 3.10-13.2) to analyze a dump. Depending on your service contract, you might also want to send a dump to IBM® support to be analyzed.

Visit `http://lkcd.sourceforge.net` for more information on Linux dump analysis.

Table 1 summarizes the available dump tools:

*Table 1. Dump tools summary*

| **Tool** | **Stand-alone tools** | | | | **VMDUMP** |
|---|---|---|---|---|---|
| | **DASD** | **Multi-volume DASD** | **SCSI** | **Tape** | |
| **Environment** | VM and LPAR | VM and LPAR | VM[1] and LPAR | VM and LPAR | VM only |
| **z/VM® NSS and DCSS** | No | No | N/A | No | Yes |
| **Size** | small, depending on disk size(2) | large, up to 32 DASD partitions | large, depending on SCSI disk and what other data it contains | large because of multivolume support | 2 GB up to z/VM 5.2 |
| **Speed** | fast | fast | fast | slow | slow |
| **Medium** | ECKD™ or FBA(3) DASD | ECKD DASD | Linux file system on a SCSI disk | tape cartridges | VM reader |
| **Compression possible** | no | no | yes | yes(4) | no |
| **Disruptive**(5) | yes | yes | yes | yes | no |

**Note:**

1. As of z/VM 5.4.
2. ECKD model 27, for example, provides 27 GB.
3. As of z/VM 5.1, SCSI disks can be emulated as FBA disks. This dump method can, therefore, be used for SCSI-only VM installations.
4. IBM TotalStorage® Enterprise Tape System 3590 and IBM 3490 Magnetic Tape Subsystem offer hardware compression.
5. The dump process kills a running operating system.

## Note on device nodes

In all examples, the traditional device nodes for DASD, tape, and SCSI devices are used. If you are using a Linux distribution that provides udev, you can also use the device nodes that udev creates for you. Refer to your distribution documentation to find out which nodes are available.

## Stand-alone tools

Four stand-alone dump tools are shipped in the s390-tools package as part of the zipl package:

- DASD dump tool for dumps on a single DASD device
- Multi-volume DASD dump tool for dumps on a set of ECKD DASD devices
- Tape dump tool for dumps on (channel-attached) tape devices
- SCSI disk dump tool for dumps on SCSI disks

You need to install these tools on the *dump device*. The dump device is the device you want to use for dumping the memory. If you install dump tools that are compiled for 64-bit, you can create both 64-bit and 31-bit Linux dumps. If you install dump tools that are compiled for 31-bit, you can create 31-bit Linux dumps only.

Typically, the system operator initiates a dump after a system crash, but you can initiate a dump at any time. To initiate a dump, you must IPL the dump device. This is destructive, that is, the running Linux operating system is killed. The IPL process writes the system memory to the IPL device (DASD and tape) or directly to a file on a SCSI disk.

You can configure a dump device that is automatically used when a kernel panic occurs. For more information, see “The dumpconf tool” on page 32.

All examples for installing stand-alone tools by using a zipl configuration file assume that `/etc/zipl.conf` is used as the configuration file and that `/etc/zipl.conf` is the default configuration file.

For more information on zipl, refer to the zipl man page and to the zipl description in *Linux on System z Device Drivers, Features, and Commands*. You can find the latest version of this document on developerWorks® at:

`http://www.ibm.com/developerworks/linux/linux390/development_documentation.html`

## VMDUMP

You can use the VM dump tool VMDUMP for the following types of Linux instances:

- VM guests on z/VM 5.1 or earlier with up to 2 GB memory
- VM guests on z/VM 5.2 or later with memory greater than 2 GB

The VMDUMP tool is a part of z/VM and does not need to be installed separately. Dumping with VMDUMP is not destructive. If you dump an operating Linux instance, the instance continues running after the dump is completed.

VMDUMP can also create dumps for VM guests that use z/VM named saved systems (NSS) and discontiguous saved segments (DCSS).

Do not use VMDUMP to dump large VM guests; the dump process is very slow. Dumping 1 GB of storage can take up to 15 minutes depending on the used storage server and z/VM version.

For more information on VMDUMP refer to *z/VM CP Command and Utility Reference*, SC24-6008.

# Chapter 2. Using a DASD dump device

This chapter provides information on how to install the stand-alone DASD dump tool, how to perform the dump process, and how to copy the dump to a file in a Linux file system.

DASD dumps are written directly to a DASD partition that has not been formatted with a file system. The following DASD types are supported:

- ECKD DASDs
  - 3380
  - 3390
- FBA DASDs

## Installing the DASD dump tool

**Requirement:** You need an unused DASD partition with enough space (memory size + 10 MB) to hold the system memory. If the system memory exceeds the capacity of a single DASD partition, you should use the multi-volume dump tool, see Chapter 3, “Using DASD devices for multi-volume dump,” on page 7.

This section describes how to install the DASD dump tool on an unused DASD partition. Dumps are written to this partition.

The examples in this section assume that `/dev/dasdc` is the dump device and that we want to dump to the first partition `/dev/dasdc1`.

The steps you need to perform for installing the DASD dump tool depend on your type of DASD, ECKD or FBA:

- If you are using an ECKD-type DASD, perform all three of the following steps:
- If you are using an FBA-type DASD, skip steps 1 and 2 and perform step 3 only:

1. Format your DASD with dasdfmt (ECKD only). A block size of 4 KB is recommended:

   **Example:**

   ```
   # dasdfmt -f /dev/dasdc -b 4096
   ```

2. Create a partition with fdasd (ECKD only). The partition must be sufficiently large (the memory size + 10 MB):

   **Example:**

   ```
   # fdasd /dev/dasdc
   ```

3. Install the dump tool using the zipl command. You can specify the dump device on the command line or use a configuration file.

   **Command line example:**

   ```
   # zipl -d /dev/dasdc1
   ```

   **Configuration file example:**

   a. Edit `/etc/zipl.conf` to add the following lines:

      ```
      [dump_dasd]
      dumpto=/dev/dasdc1
      ```

b. Issue:

```
# zipl dump_dasd
```

**Note:** When using an ECKD-type DASD formatted with the traditional Linux disk layout ldl, the dump tool must be reinstalled using zipl after each dump.

## Initiating a DASD dump

To obtain a dump with the DASD dump tool, perform the following main steps:

1. Stop all CPUs.
2. Store status on the IPL CPU.
3. IPL the dump tool on the IPL CPU.

   **Note:** Do not clear storage!

   The dump process can take several minutes depending on the device type you are using and the amount of system memory. After the dump has completed, the IPL CPU should go into disabled wait.

   The following PSW indicates that the dump process has completed successfully:

   ```
   (31-bit) PSW: 000A0000 00000000
   (64-bit) PSW: 00020000 80000000 00000000 00000000
   ```

   Any other disabled wait PSW indicates an error.

   After the dump tool is IPLed, messages that indicate the progress of the dump are written to the console:

   ```
   Dumping 64 bit OS
   00000032 / 00000256 MB
   00000064 / 00000256 MB
   00000096 / 00000256 MB
   00000128 / 00000256 MB
   00000160 / 00000256 MB
   00000192 / 00000256 MB
   00000224 / 00000256 MB
   00000256 / 00000256 MB
   Dump successful
   ```
4. You can IPL Linux again.

See Appendix A, “Examples for initiating dumps,” on page 21 for more details.

## Copying the dump from DASD

This section describes how to copy a DASD dump to a file system. You can use the zgetdump tool or the lcrash tool.

For general information on zgetdump, see “The zgetdump tool” on page 29 or the man page.

lcrash is maintained within the Linux Kernel Crash Dumps (LKCD) project. For more information, refer to the documentation at `http://lkcd.sourceforge.net` or to the man page.

## Using the zgetdump tool

By default, the zgetdump tool takes the dump device as input and writes its contents to standard output. To write the dump to a file system you must redirect the output to a file.

Assuming that the dump is on DASD device `/dev/dasdb1` and you want to copy it to a file named dump_file:

```
# zgetdump /dev/dasdc1 > dump_file
```

You can also use zgetdump to display information on the dump. See “Checking whether a DASD dump is valid and printing the dump header” on page 32 for an example.

## Using the lcrash tool

The ’-s’ (save dump) option of the LKCD crash analysis tool lcrash copies a dump from a DASD dump device to a file. The resulting dump is gzip compressed. This option is available with lkcdutils-4.2 or higher.

To copy a dump from DASD to a file system, call lcrash with the ’-s’ (save dump) and ’-d’ (dump device) options.

The ’-s’ option specifies the destination directory for the resulting dump file. If the destination directory contains a file ’bounds’ which contains an ASCII integer *<n>*, lcrash uses this number to generate a dump file name of the form dump.*<n>*. After a dump has been written successfully, lcrash updates the bounds file and increments the number by 1.

If there is no bounds file, lcrash uses dump.0 as the dump file name. If there is no bounds file and a file dump.0 already exists, lcrash replaces the existing file dump.0 with the new dump.

You can optionally specify the ’-p’ option to display the progress of saving the dump.

**Example:**

```
# cat /tmp/bounds
# 2
# lcrash -s /tmp -d /dev/dasdc1 -p
lcrash
Lcrash is free software. It is covered by the GNU General Public License.
You are welcome to change it and/or distribute copies of it under certain
conditions. Type "help -C" to see the conditions. Absolutely no warranty
is given for Lcrash. Type "help -W" for warranty details.

   - 100.0%

# ls /tmp
# bounds dump.2
# cat /tmp/bounds
# 3
```

The ’-s’ option is equivalent to using the lcrash savedump command (available with lkcdutils-4.2 or higher) but does not require the map and kerntypes files to be present. By using the savedump command, you can reduce the dump size further by discarding specific memory pages. Refer to the LKCD documentation for details.

## Checking whether a dump is valid and printing the dump header

To print the dump file header and check if the dump is valid use lcrash with options '-i' and '-d'.

**Example:**

```
# lcrash -i -d /dev/dasdc1
        Dump Type: s390 standalone dump
          Machine: s390x (ESAME)
           CPU ID: 0xff10000620640000

     Memory Start: 0x0
       Memory End: 0x10000000
      Memory Size: 268435456
     Time of dump: Fri Jul 2 18:51:06 2004
  Number of pages: 65536
 Kernel page size: 4096
   Version number: 2
     Magic number: 0xa8190173618f23fd
 Dump header size: 4096
       Dump level: 0x4
       Build arch: s390x (ESAME)
 Time of dump end: Fri Jul 2 18:51:31 2004

End Marker found! Dump is valid!
```

# Chapter 3. Using DASD devices for multi-volume dump

This chapter describes how to prepare a set of ECKD DASD devices for a multi-volume dump, how to install the stand-alone dump tool on each DASD device involved, how to perform the dump process, and how to copy the dump to a file in a Linux file system. Multi-volume dumps are possible on 64-bit systems only.

You can specify up to 32 partitions on ECKD DASD volumes for a multi-volume dump. The dump tool is installed on each volume involved. The volumes must:

- Be in subchannel set 0.
- Be formatted with the compatible disk layout (cdl, the default option when using the **dasdfmt** command.)

You can use any block size, even mixed block sizes. However, to speed up the dump process and to reduce wasted disk space, use block size 4096.

For example, Figure 1 shows three DASD volumes, dasdb, dasdc, and dasdd, with four partitions selected to contain the dump. To earmark the partition for dump, a dump signature is written to each partition.

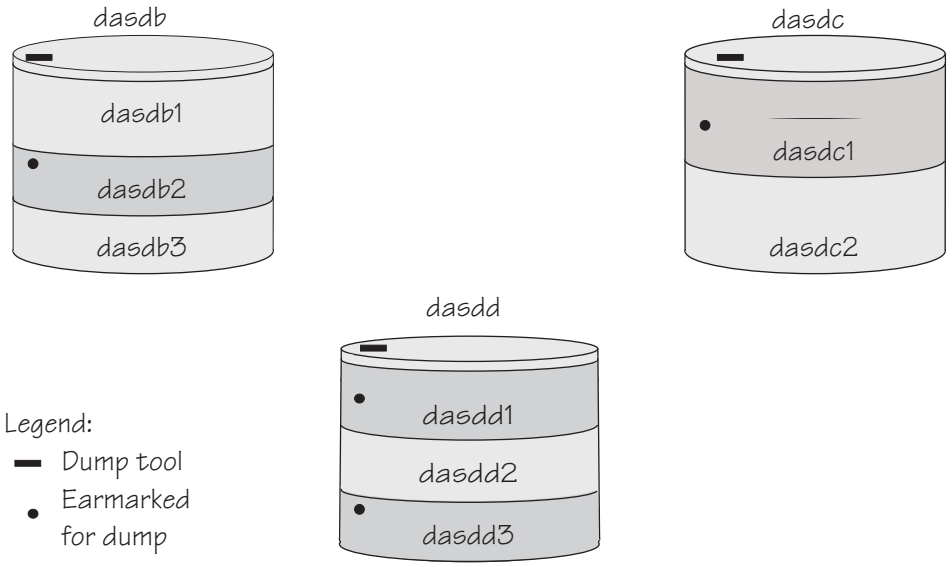



*Figure 1. Three DASD volumes with four partitions for a multi-volume dump*

The partitions need to be listed in a configuration file, for example:

```
/dev/dasdb2
/dev/dasdc1
/dev/dasdd1
/dev/dasdd3
```

You can define a maximum of three partitions on one DASD. All three volumes are prepared for IPL; regardless of which you use the result is the same.

The following sections will take you through the entire process of creating a multi-volume dump.

## Installing the multi-volume DASD dump tool

This example shows how to perform the dump process on two partitions, /dev/dasdc1 and /dev/dasdd1, which reside on ECKD volumes /dev/dasdc and /dev/dasdd.

Assume that the corresponding bus IDs (as displayed by lsdasd) are 0.0.4711 and 0.0.4712, so the respective device numbers are 4711 and 4712.

1. Format both dump volumes with dasdfmt. Specify cdl (compatible disk layout), which is the default. Preferably, use a block size of 4 KB:

```
# dasdfmt -f /dev/dasdc -b 4096
# dasdfmt -f /dev/dasdd -b 4096
```

2. Create the partitions with **fdasd**. The sum of the partition sizes must be sufficiently large (the memory size + 10 MB):

```
# fdasd /dev/dasdc
# fdasd /dev/dasdd
```

3. Create a file called sample_dump_conf containing the device nodes of the two partitions, separated by one or more line feed characters (0x0a). The file's contents looks as follows:

```
/dev/dasdc1
/dev/dasdd1
```

4. Prepare the volumes using the **zipl** command. You can specify the dump list on the command line or use the zipl configuration file.

   Command line example:

```
# zipl -M sample_dump_conf
Dump target: 2 partitions with a total size of 1234 MB.
Warning: All information on the following partitions will be lost!
/dev/dasdc1
/dev/dasdd1
Do you want to continue creating multi-volume dump partitions (y/n)?
```

   zipl configuration file example:

   a. Edit /etc/zipl.conf to add the following lines:

```
[multi_volume_dump]
mvdump=sample_dump_conf
```

   b. Issue:

```
# zipl multi_volume_dump
```

Now the two volumes /dev/dasdc and /dev/dasdd with device numbers 4711 and 4712 are prepared for a multi-volume dump. Use the -device option of **zgetdump** to display information on the involved volumes:

```
# zgetdump -d /dev/dasdc
'/dev/dasdc' is part of Version 1 multi-volume dump,
which is spread along the following DASD volumes:
0.0.4711 (online, valid)
0.0.4712 (online, valid)
Dump size limit: none
Force option specified: no
```

During **zipl** processing both partitions were earmarked for dump with a valid dump signature. The dump signature ceases to be valid when data other than dump data is written to the partition. For example, writing a file system to the partition overwrites the dump signature. Before writing memory to a partition the dump tool checks the partition's signature and exits if the signature is invalid. Thus any data inadvertently written to the partition is protected.

You can circumvent this protection, for example, if you want to use a swap space partition for dumping, by using the **zipl** `--force` option. The force option inhibits the dump signature check, and any data on the device is overwritten. Exercise great caution when using the force option!

The **zipl** command also takes a size specification, see Appendix B, "Obtaining a dump with limited size," on page 27. For more details on **zipl**, refer to the description of the **zipl** command in the *Device Drivers, Features, and Commands*.

## Initiating a multi-volume DASD dump

To obtain a dump with the multi-volume DASD dump tool, perform the following main steps:

1. Stop all CPUs.
2. Store status on the IPL CPU.
3. IPL the dump tool using one of the prepared volumes, either 4711 or 4712.

   **Note:** Do not clear storage!

   The dump process can take several minutes depending on each volume's block size and the amount of system memory. After the dump has completed, the IPL CPU should go into disabled wait.

   The following PSW indicates that the dump process has completed successfully:

   ```
   (64-bit) PSW: 00020000 80000000 00000000 00000000
   ```

   Any other disabled wait PSW indicates an error.

   After the dump tool is IPLed, messages that indicate the progress of the dump are written to the console:

   ```
   Dumping 64 bit OS
   Dumping to: 4711
   00000128 / 00001024 MB
   00000256 / 00001024 MB
   00000384 / 00001024 MB
   00000512 / 00001024 MB
   Dumping to: 4712
   00000640 / 00001024 MB
   00000768 / 00001024 MB
   00000896 / 00001024 MB
   00001024 / 00001024 MB
   Dump successful
   ```
4. You can IPL Linux again.

## Copying a multi-volume dump to a file

At this point the two volumes /dev/dasdc and /dev/dasdd (with device numbers 4711 and 4712) contain the dump. Dump data is spread along partitions /dev/dasdc1 and /dev/dasdd1.

Use zgetdump without any option to copy the dump parts to a file:

```
# zgetdump /dev/dasdc > multi_volume_dump_file
Dump device: /dev/dasdc

>>> Dump header information <<<
Dump created on: Wed Apr 16 09:06:01 2008

Magic number: 0xa8190173618f23fd
Version number: 4
Header size: 4096
Page size: 4096
Dumped memory: 1073741824
Dumped pages: 262144
Real memory: 1073741824
cpu id: 0xff00012320948000
System Arch: s390x (ESAME)
Build Arch: s390x (ESAME)
>>> End of Dump header <<<

Multi-volume dump: Disk 1 (of 2)
Reading dump contents from 0.0.4711................

Multi-volume dump: Disk 2 (of 2)
Reading dump contents from 0.0.4712...............

Dump ended on: Wed Apr 16 09:07:03 2008

Dump End Marker found: this dump is valid.
```

If you want to only check the validity of the multi-volume dump rather than copying it to a file use the `-info` option with **zgetdump**. See “Checking whether a DASD dump is valid and printing the dump header” on page 32 for an example.

# Chapter 4. Using a tape dump device

This chapter provides information on how to install the stand-alone tape dump tool, how to perform the dump process, and how to copy the dump to a file in a Linux file system.

The following tape devices are supported:

- 3480
- 3490
- 3590

## Installing the tape dump tool

**Requirement:** Have enough empty tapes ready to hold the system memory (memory size + 10 MB).

The examples in this section assume that `/dev/ntibm0` is the tape device you want to dump to.

Perform™ these steps to install the tape dump tool:

1. Insert an empty dump cartridge into your tape device.
2. Ensure that the tape is rewound.
3. Install the dump tool using the zipl command. You can specify the dump device on the command line or use a configuration file.

   **Command line example:**

   ```
   # zipl -d /dev/ntibm0
   ```

   **Configuration file example:**

   a. Edit `/etc/zipl.conf` to add the following lines:

   ```
   [dump_tape]
   dumpto=/dev/ntibm0
   ```

   b. Issue zipl:

   ```
   # zipl dump_tape
   ```

## Initiating a tape dump

You can accommodate a large dump by using multiple tapes. Only the first tape (that you IPL from) needs to have the tape dump tool installed.

To obtain a dump with the tape dump tool, perform the following main steps:

1. Set the cartridge loader to AUTO and insert a sufficient number of cartridges.

   **Attention:** The dump tool loads tapes automatically from the cartridge holder and overwrites any data on them. Be sure that the cartridge holder does not hold tapes with data that are still needed.
2. Ensure that the tapes are rewound.
3. Stop all CPUs.
4. Store status on the IPL CPU.
5. IPL the dump tool on the IPL CPU.

**Note:** Do not clear storage!

The dump tool writes messages to the tape drive message display (not to the operator console). First the number of dumped MB is displayed. When a tape cartridge is full, it is automatically unloaded and the message `next*vol` is displayed. If more cartridges are available, they are loaded and the dump continues. If no cartridge is available, the dump tool waits for the operator to load one.

The dump process can take several minutes, depending on the device type you are using and the amount of system memory available. When the dump is complete, the message `dump*end` is displayed and the IPL CPU should go into disabled wait.

The following PSW indicates that the dump was taken successfully:

```
(31-bit) PSW: 000A0000 00000000
(64-bit) PSW: 00020000 80000000 00000000 00000000
```

Any other disabled wait PSW indicates an error.

After the dump tool is IPLed, messages that indicate the progress of the dump are written to the console:

```
Dumping 64 bit OS
00000032 / 00000256 MB
00000064 / 00000256 MB
00000096 / 00000256 MB
00000128 / 00000256 MB
00000160 / 00000256 MB
00000192 / 00000256 MB
00000224 / 00000256 MB
00000256 / 00000256 MB
Dump successful
```

6. You can IPL Linux again.

See Appendix A, “Examples for initiating dumps,” on page 21 for more details.

## Tape display messages

**next*vol**
: The dump tool loads the next tape cartridge, or, if none is available, waits for the operator to load one.

***number***
: The number of MB dumped.

**dump*end**
: The dump process ended successfully.

# Copying the dump from tape

This section describes how to copy a tape dump to a file system using the zgetdump tool.

**Prerequisite:** You must have installed the mt utility.

## Preparing the dump tape

You need to rewind the tape, and find the correct position on the tape to start copying from. Use the mt tool to do this.

1. Rewind the tape.

   **Example:**

```
# mt -f /dev/ntibm0 rewind
```

2. Skip the first file on the tape (this is the dump tool itself).

   **Example:**

```
# mt -f /dev/ntibm0 fsf
```

## Using the zgetdump tool

For a multivolume dump, the cartridges must be loaded in the right order, starting with the first volume. You can use the cartridge loader for automatic loading. When zgetdump finds the end of a volume (that is not the end of the dump) it writes a message and attempts to load the next cartridge.

By default, the zgetdump tool takes the dump device as input and writes its contents to standard output. To write the dump to a file system you must redirect the output to a file.

**Note:** Always use the AUTO setting on your tape device when working with zgetdump.

**Example:** Assuming that the tape is in the correct position (see "Preparing the dump tape" on page 12) and is on tape device `/dev/ntibm0`, use the following command to copy the dump from tape to a file dump_file in the file system:

```
# zgetdump /dev/ntibm0 > dump_file
```

For general information on zgetdump, see "The zgetdump tool" on page 29 or the man page.

### Checking whether a dump is valid, and printing the dump header

To check whether a single-volume or a multivolume dump is valid, use the **-i** option. For multivolume dumps, use the **-a** option to signal that you are working with a multivolume dump. For example, to check whether a multivolume dump is valid:

1. Ensure that the volumes are loaded in the correct sequence.
2. Skip the first file on the first tape (this is the dump tool itself):

```
# mt -f /dev/ntibm0 fsf
```

3. Issue:

```
# zgetdump -i -a /dev/ntibm0
```

   zgetdump goes through all the volumes until it reaches the end of the dump. See also "Using zgetdump to copy a multi-volume tape dump" on page 31.

# Chapter 5. Using a SCSI dump device

You can use SCSI disks that are accessed through the zfcp device driver as dump devices. SCSI disk dumps are written as files in an existing file system on the dump partition. No copying is necessary.

This section describes how to install the SCSI dump tool and how to initiate a SCSI dump.

## Installing the SCSI disk dump tool

**Requirement:** The dump directory needs enough free space (memory size + 10 MB) to hold the system memory.

The SCSI dump tool (also referred to as the SCSI Linux System Dumper, or SD) is written to one partition, referred to here as the *target partition*. The dump can be written to a second partition, the *dump partition*, provided it is on the same physical disk. Only the target partition need be mounted when zipl is run. In a single-partition configuration, the target partition is also the dump partition.

## SCSI dump tool parameters

When installing the SCSI disk dump tool, the following parameters can be specified in a 'parameters' line in the zipl configuration file or using the '-P' option in the zipl command line.

**dump_dir=/**<*directory*>

Path to the directory (relative to the root of the dump partition) to which the dump file is to be written. This directory is specified with a leading slash. The directory must exist when the dump is initiated.

**Example:** If the dump partition is mounted as `/dumps`, and the parameter "dump_dir=/mydumps" is defined, the dump directory would be accessed as "/dumps/mydumps".

The default is "/" (the root directory of the partition).

**dump_compress=gzip|none**

Dump compression option. Compression can be time-consuming on slower systems with a large amount of memory.

The default is "none".

**dump_mode=interactive|auto**

Action taken if there is no room on the file system for the new dump file. "interactive" prompts the user to confirm that the dump with the lowest number is to be deleted. "auto" automatically deletes this file.

The default is "interactive".

## Example 1: Combined dump and target partition

This example assumes that `/dev/sda` is a SCSI device that contains no data and is to be used exclusively as a dump device. Because no other data is to be stored on the device, a single partition is created that serves as both dump and target partition. The example also shows how to use the **dump_compress** parameter to generate the dump in gzip format.

1. Create a single partition with fdisk, using the PC-BIOS layout:

   **Example:**

```
# fdisk /dev/sda
```

The created partition is `/dev/sda1`.

2. Format this partition with a file system that is supported by the SCSI dump tool (for example, ext2 or ext3).

   **Example:**

   ```
   # mke2fs /dev/sda1
   ```

3. Mount the partition at a mount point of your choice and create a subdirectory to hold the dump files.

   **Example:**

   ```
   # mount /dev/sda1 /dumps
   # mkdir /dumps/mydumps
   ```

4. Install the dump tool using the zipl command. You can specify the dump device on the command line or use a configuration file.

   **Command line example:**

   ```
   # zipl -D /dev/sda1 -t /dumps -P "dump_dir=/mydumps dump_compress=gzip"
   ```

   **Configuration file example:**

   a. Edit `/etc/zipl.conf` to add the following lines:

      ```
      [scsidump]
      target=/dumps
      dumptofs=/dev/sda1
      parameters="dump_dir=/mydumps dump_compress=gzip"
      ```

   b. Issue zipl:

      ```
      # zipl scsidump
      ```

5. Unmount the file system:

   ```
   # umount /dumps
   ```

When you IPL `/dev/sda1` using boot program selector 1 or 0 (default), the dump is written to directory `mydumps` on partition 1 of `/dev/sda`. The boot program selector is located on the load panel, see Figure 3 on page 25 for an example.

## Example 2: Menu configuration with separate dump and target partitions

This example assumes that a SCSI device `/dev/sda` is to be used as a dump device. In the example, the dump configuration is part of a menu configuration. Menu configurations are specified in a zipl configuration file and have a common target directory that is specified in the menu section of the configuration file. To keep the dumps separated from other data, separate dump and target partitions are used. The example assumes that there are already three partitions:

- `/dev/sda1` is the production partition and mounted as the root file system.
- `/dev/sda2` is the target partition, has been formatted with the PC-BIOS disk layout, and is mounted under `/boot`. `/boot` contains files for two Linux boot configurations (parmfile, image-1, and image-2).

- `/dev/sda3` is the dump partition and has been formatted with the PC-BIOS disk layout. The dump files are to be written to the root directory of the dump partition.

1. On the dump partition, create a file system that is supported by the SCSI dump tool (for example, ext2 or ext3):

```
# mke2fs /dev/sda3
```

2. Edit `/etc/zipl.conf` to add the following lines:

```
[ipl1]
image=/boot/image-1
parmfile=/boot/parmfile
target=/boot

[ipl2]
image=/boot/image-2
parmfile=/boot/parmfile
target=/boot

[scsidump1]
dumptofs=/dev/sda3
parameters="dump_compress=gzip"
target=/boot

# Menu containing all 3 configurations
:menu1
1=ipl1
2=ipl2
3=scsidump1
default=1
target=/boot
```

3. Install the menu configuration, including the dump tool, by issuing:

```
# zipl --menu menu1
```

When you specify the “scsidump1” configuration at IPL-time using boot program selector 3, the dump configuration is used and a system dump is initiated. The boot program selector is located on the load panel, see Figure 3 on page 25 for an example.

For more information on using a configuration file, see the `zipl.conf` man page or refer to *Linux on System z Device Drivers, Features, and Commands*.

## Initiating a SCSI dump

To initiate the dump, IPL the dump tool using the **SCSI dump** load type. See Appendix A, “Examples for initiating dumps,” on page 21.

The dump process can take several minutes depending on the device type you are using and the amount of system memory. The dump progress and any error messages are reported on the operating system messages console.

The dump process creates a new dump file in the dump directory. All dumps are named dump.*<n>* where *<n>* is the dump number. A new dump receives the next highest dump number out of all dumps in the dump directory (see the **dump_dir** parameter under “SCSI dump tool parameters” on page 15).

**Example:** If there are already two dump files, “dump.0” and “dump.1”, in the dump directory, the new dump will be “dump.2”.

When the dump completes successfully, you can IPL Linux again.

See Appendix A, “Examples for initiating dumps,” on page 21 for more details.

You do not need to convert the dump or copy it to a different medium. To access the dumps, mount the dump partition.

## Printing the dump header

To print the dump file header use lcrash with the ’-i’ and ’-d’ option.

```
# lcrash -i -d dump.0
        Dump Type: LKCD-Dump
       Systemname:
         Nodename:
          Release:
          Version:
          Machine: s390x
       Domainname:

     Memory Start: 0x0
       Memory End: 0x80000000
      Memory Size: 0x80000000

     Time of dump: Mon Aug 21 21:28:36 2006
     Panic string: zSeries-dump (CPUID =   17b52a20848000)
  Number of pages: 524288
 Kernel page size: 4096
   Version number: 8
     Magic number: 0xa8190173618f23ed
 Dump header size: 734
       Dump level: 0x0
```

# Chapter 6. Using VMDUMP

You can use the VM dump tool VMDUMP and write the dump to a VM reader for the following types of Linux instances:

- VM guests on z/VM 5.1 or earlier with up to 2 GB memory
- VM guests on z/VM 5.2 or later with memory greater than 2 GB

VMDUMP does not need to be installed separately.

Do not use VMDUMP to dump large VM guests; the dump process is very slow. Dumping 1 GB of storage can take up to 15 minutes depending on the used storage server and z/VM version.

This section describes how to create a dump with VMDUMP, how to transfer the dump to Linux, and how to convert the VM dump to a convenient format.

## Intitiating a dump with VMDUMP

Issue the following command from the guest's 3270 console:

```
#CP VMDUMP
```

**Result:** VM stops the Linux guest and creates a dump file in the guest's VM reader. After the dump is complete the Linux guest continues operating.

You can use the "TO" option of the VMDUMP command to direct the dump to the reader of another guest of the same VM.

**Example:** To write the dump to a VM guest "linux02" issue:

```
#CP VMDUMP TO LINUX02
```

If you want to include NSSs and DCSSs in your dump, use the "ALL" operand:

```
#cp VMDUMP 0:ALL
```

For more information on VMDUMP refer to *z/VM CP Command and Utility Reference*, SC24-6008.

## Copying the dump to Linux

You can use the vmur command under Linux or the DUMPLOAD command under CMS to copy the dump file.

## Using the vmur command

1. Find the spool ID of the VMDUMP spool file in the output of the vmur li command:

```
# vmur li

ORIGINID FILE CLASS RECORDS  CPY HOLD DATE  TIME     NAME   TYPE DIST
T6360025 0463 V DMP 00020222 001 NONE 06/11 15:07:42 VMDUMP FILE T6360025
```

In the example above the required VMDUMP file spool ID is 463.

2. Copy the dump into your Linux file system using the vmur receive command:

```
# vmur rec 463 myvmdump
```

## Using the DUMPLOAD command

Alternatively you can use the DUMPLOAD command under CMS to access the dump. The DUMPLOAD command copies the dump from the VM reader to the CMS file system.

From the CMS file system, you can then transfer the dump to a Linux file system, for example with ftp.

## Converting the dump

On Linux, you can use the vmconvert command to convert the dump into a format that can be processed with the Linux dump analysis tool lcrash or **crash**.

**Example:** To convert a VMDUMP-created dump file “myvmdump” into a dump file “mydump.lkcd” issue:

```
# vmconvert -f myvmdump -o mydump.lkcd
```

The created file, mydump.lkcd, can then be used as input to lcrash.

See “The vmconvert tool” on page 35 for more details.

# Appendix A. Examples for initiating dumps

The following sections describe how to initiate a dump from different control points.

## z/VM

The following examples assume the 64-bit mode. Corresponding 31-bit examples would have a different PSW but be the same otherwise.

### Using DASD

If 193 is the dump device:

```
#cp cpu all stop
#cp store status
#cp i 193
```

On z/VM, a three-processor machine in this example, you will see messages about the disabled wait:

```
01: The virtual machine is placed in CP mode due to a SIGP stop from CPU 00.
02: The virtual machine is placed in CP mode due to a SIGP stop from CPU 00.
"CP entered; disabled wait PSW 00020000 80000000 00000000 00000000"
```

You can now IPL your Linux instance and resume operations.

### Using tape

If 193 is the tape device:

```
#cp rewind 193
#cp cpu all stop
#cp store status
#cp i 193
```

On z/VM, a three-processor machine in this example, you will see messages about the disabled wait:

```
01: The virtual machine is placed in CP mode due to a SIGP stop from CPU 00.
02: The virtual machine is placed in CP mode due to a SIGP stop from CPU 00.
"CP entered; disabled wait PSW 00020000 80000000 00000000 00000000"
```

You can now IPL your Linux instance and resume operations.

### Using SCSI

**Prerequisite**: SCSI dump from VM is supported as of z/VM 5.4.

Assume your SCSI dump disk has the following parameters:

- WWPN: 4712076300ce93a7
- LUN: 4712000000000000
- FCP adapter device number: 4711
- Boot program selector: 3

To initiate the dump process, follow these steps:

```
#cp set dumpdev portname 47120763 00ce93a7 lun 47120000 00000000 bootprog 3
#cp ipl 4711 dump
```

Messages on the operating system console will show when the dump process is finished.

You can now IPL your Linux instance and resume operations.

## Using VMDUMP

To initialize a dump with VMDUMP issue this command from your Linux guest's 3270 console:

```
#cp vmdump
```

Dumping does not force you to IPL. If the Linux instance ran as required before dumping, it will continue running when the dump is completed.

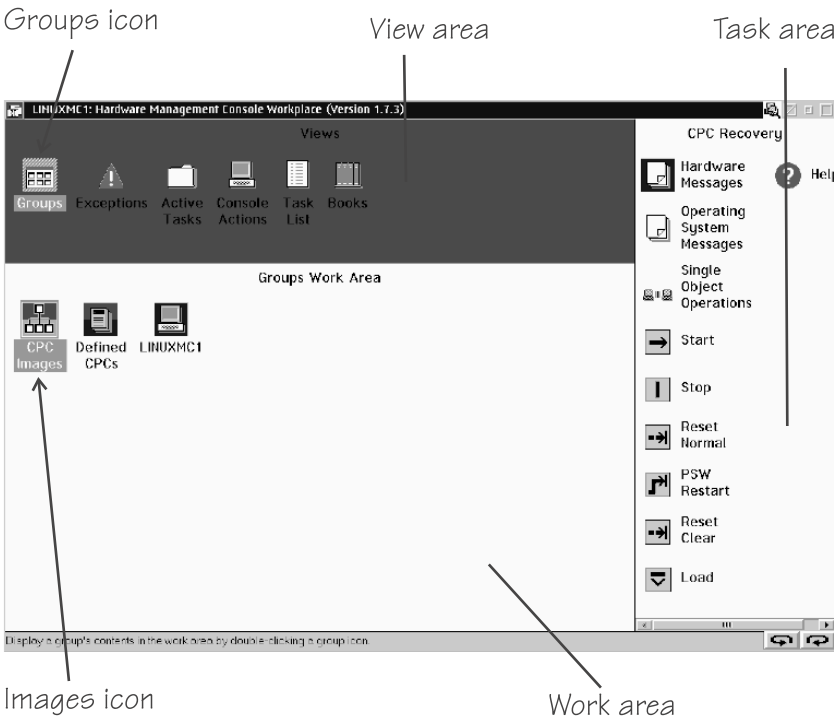
# HMC or SE

You can initiate a dump process on an LPAR from an HMC (Hardware Management Console) or SE (Support Element). The following description refers to an HMC, but the steps also apply to an SE.

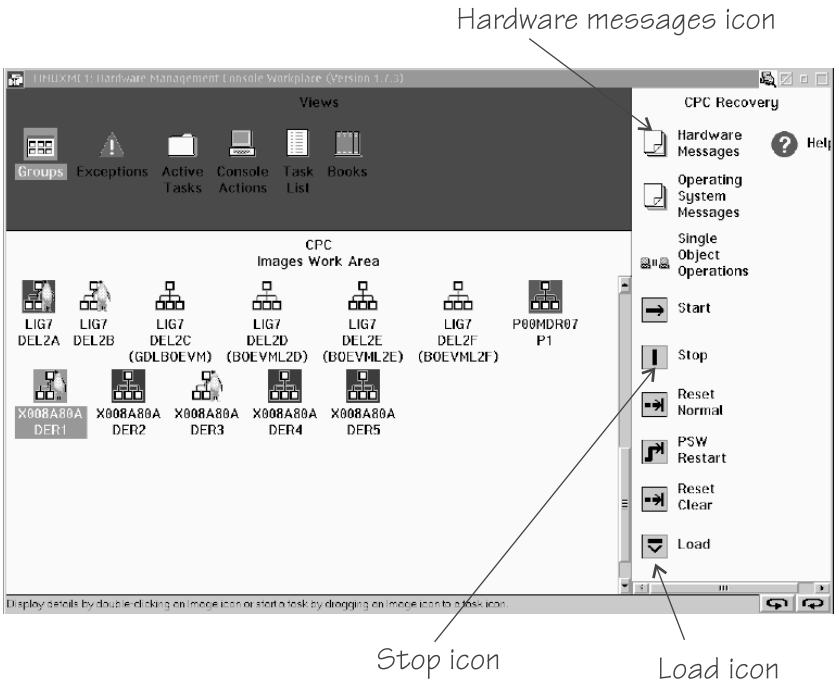
The steps are similar for DASD, tape, and SCSI. Differences are noted where applicable. You cannot initiate a dump with VMDUMP from the HMC or SE.

To initiate the dump:

1. Click the Groups icon in the Views Area of the HMC to display the Groups Work Area.




2. Click the Images icon in the Groups Work Area to display the CPC Images Work Area with all defined images.




**Note:** The appearance of the Stop and Start icons can vary. On some consoles they appear as green  and red  traffic lights.

3. Select the image for which you want to initiate the dump.
4. Proceed according to your dump device:

- If you are dumping to DASD or tape, click the Stop icon in the Task Area to stop all CPUs. Confirm when you are prompted to do so.
- If you are dumping to a SCSI disk, skip this step and proceed with step 5.

5. Click the Load icon in the Task Area to display the Load panel.

   **For a dump to DASD or tape:**

   a. Select **Load type** “Normal”.
   b. Select the **Store status** check box.
   c. Type the device number of the dump device into the **Load address** field.

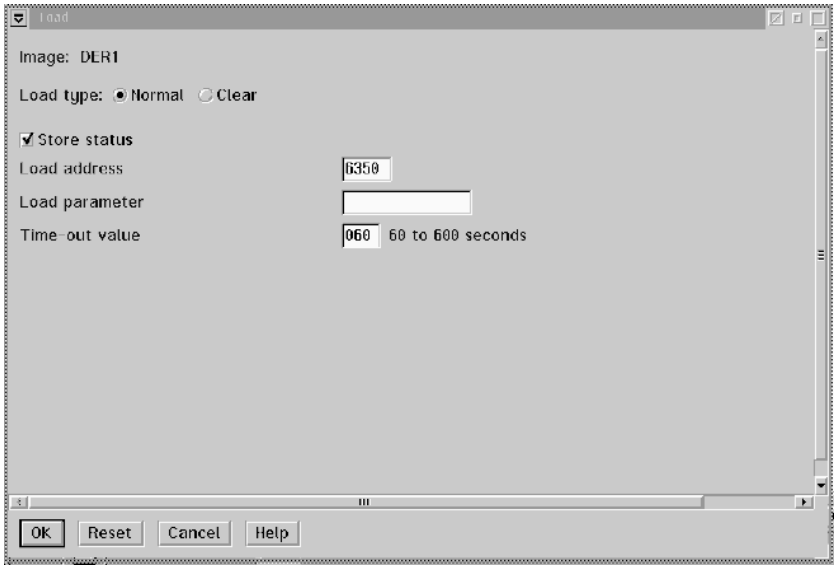



*Figure 2. Load panel for dumping to DASD or tape*

   **For a dump to SCSI disk:**

   a. Select **Load type** ″SCSI dump″.
   b. Type the device number of the FCP adapter for the SCSI disk into the **Load address** field.
   c. Type the World Wide Port name of the SCSI disk into the **World wide port name** field.
   d. Type the Logical Unit Number of the SCSI disk into the **Logical unit number** field.
   e. Type the configuration number of the dump IPL configuration in the **Boot program selector** field.

      The ’configuration number’ defines the IPL or dump configuration which is to be IPLed. The numbering starts with 1 and is related to the menu of IPL/dump entries in the zipl configuration file for the SCSI disk. Configuration number 0 specifies the default configuration. In “Example 2: Menu configuration with separate dump and target partitions” on page 16, the dump configuration has the number 3.
   f. Leave the fields **Load parameter**, **Boot record logical block address**, and **OS specific load parameters** blank.

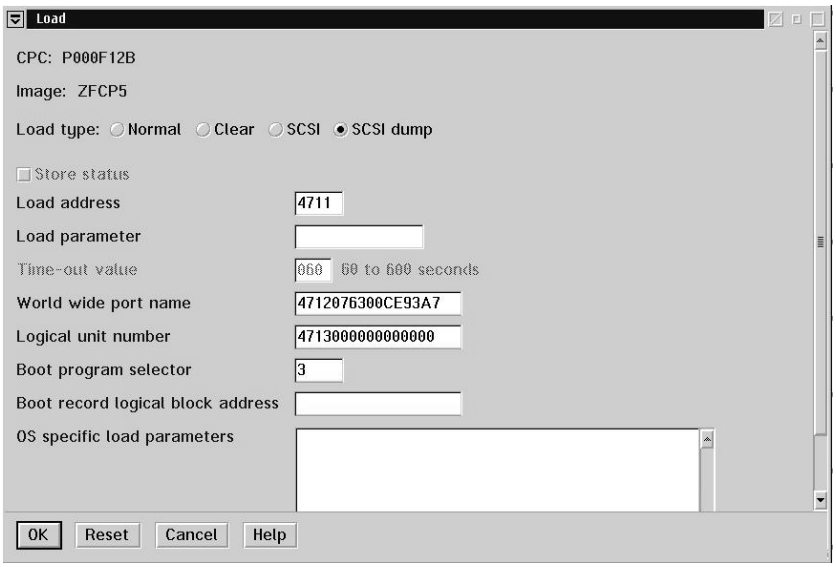



*Figure 3. Load panel with enabled SCSI feature for dumping to SCSI disk*

6. Click **OK** to start the dump.
7. Wait until the dump process completes. Click the Operating System Messages icon for progress and error information.

When the dump has completed successfully, you can IPL Linux again.

# Appendix B. Obtaining a dump with limited size

The “mem” kernel parameter can make Linux use less memory than is available to it. A dump of a Linux system like this does not need to include the unused memory. You can use the zipl “size” option to limit the amount of memory that is dumped.

The “size” option is available for all zipl based dumps: DASD, tape, and SCSI, in command line mode or in configuration file mode. The “size” option is appended to the dump device specification, with a comma as separator.

The value is a decimal number that can optionally be suffixed with K for kilobytes, M for megabytes, or G for gigabytes. Values specified in byte or kilobyte are rounded to the next megabyte boundary.

Be sure not to limit the dump size below the amount of memory actually used by the system to be dumped. Limiting the size to below the amount of used memory results in an incomplete dump.

**Example:** The following command prepares a DASD dump device for a dump that is limited to 100 megabyte:

```
# zipl -d /dev/dasdc1,100M
```

An equivalent section in a configuration file could look like this:

```
[dump1]
dumpto=/dev/dasdc1,100M
```

# Appendix C. Command summary

This chapter describes tools to work with dumps. The descriptions of the commands contain only the relevant options and parameters, for a full description refer to the man pages.

- The zgetdump tool
- The dumpconf tool
- The crash tool
- The lcrash tool
- The vmconvert tool

## The zgetdump tool

The **zgetdump** tool reads a dump from the given dump device and writes its contents to standard out, unless the operator redirects it to a file.

**zgetdump Command**

```
                                                  ┌─standard out──┐
►►─zgetdump──┬──┬──────────┬──┬──────────────── <dumpdevice>──┬──────────────┬──────────────►◄
             │  └─ -i ──┬──┬┘                                 └─ > <dump_file>─┘
             │          └─ -a─┘
             ├─ -d─ <dumpdevice>──────────────────────────────────────────────┤
             ├─ -h──────────────────────────────────────────────────────────┤
             └─ -v──────────────────────────────────────────────────────────┘
```

Where:

*<dumpdevice>*
: specifies the device or partition as follows:
  - For single-volume DASD: The partition containing the dump, for example `/dev/dasdb1`
  - For multi-volume DASD: The device node of one of the DASD devices containing the dump, for example `/dev/dasdb`
  - For tape: The device node of the tape containing the dump, for example `/dev/ntibm0`
  - For the `-d` option: The device node of the DASD device, for example `/dev/dasdb`

*<dump_file>*
: is the file to which the output is redirected. The default is standard out.

**-i or --info**
: displays the header information from the dump and performs a validity check.

**-a**
: signals that the dump is a multi-volume tape dump.

**-d**
: checks whether the specified ECKD or FBA device contains a valid dump record.

**-h or --help**
displays the help information for the command.

**-v or --version**
displays the version information for the command.

## Examples

### Using zgetdump to copy a dump

Assuming that the dump is on DASD partition `/dev/dasdb1` and that you want to copy it to a file named dump_file:

```
# zgetdump /dev/dasdb1 > dump_file
```

### Using zgetdump to transfer a dump with FTP

Follow these steps to transfer a dump with FTP:

1. Establish an FTP session with the target host and log in.
2. To transfer a file in binary mode, enter the FTP **binary** command:

   ```
   ftp> binary
   ```

3. To send the dump file to the host issue a command of the following form:

   ```
   ftp> put |"zgetdump /dev/dasdb1" <dump_file_on_target_host>
   ```

### Using zgetdump to copy a multi-volume dump

Assuming that the dump is on DASD devices `/dev/dasdc` and `/dev/dasdd` spread along partitions `/dev/dasdc1` and `/dev/dasdd1` and that you want to copy it to a file named multi_volume_dump_file:

```
# zgetdump /dev/dasdc > multi_volume_dump_file
```

For an example of the output from this command, see “Copying a multi-volume dump to a file” on page 10.

## Using zgetdump to copy a multi-volume tape dump

Assuming that the tape device is /dev/ntibm0:

```
# zgetdump /dev/ntimb0 > dump_file
Dump device: /dev/ntibm0

Tape Volume 0

>>>  Dump header information  <<<
Dump created on: Wed Jul  7 17:20:16 2004
Magic number:    0xa8190173618f23fd
Version number:  2
Header size:     4096
Page size:       4096
Physical memory: 268435456
Number of pages: 65536
cpu id:          0xff02453096720000
System Arch:     s390 (ESA)
Build Arch:      s390
>>>  End of Dump header  <<<

Reading dump content ..........................
End of Volume reached.

Waiting for next volume to be loaded... done

Tape Volume 1 of a multi volume dump.
Reading dump content ......
Dump ended on:   Wed Jul  7 17:23:31 2004

Dump End Marker found: this dump is valid.
```

## Checking whether a multi-volume tape dump is valid, and printing the dump header

Assuming that the tape device is /dev/ntibm0:

```
# zgetdump -i -a /dev/ntibm0

 "zgetdump -i -a" checks if a multi-volume tape dump is valid.
 Please make sure that all volumes are loaded in sequence.

 Dump device: /dev/ntibm0

 Tape Volume 0

 >> Dump header information <<<
 ...

 >> End of Dump header <<<

 Checking if the dump is valid - this might take a while...
 Reached End of Volume 0.
 Waiting for Volume 1 to be loaded... done

 Tape Volume 1 of a multi volume dump.
 Dump End found: This Dump is valid.
```

### Checking whether a DASD dump is valid and printing the dump header

Assuming that the dump is on a partition, part1, of a DASD device `/dev/dasdb1`:

```
# zgetdump -i /dev/dasdb1

> zgetdump -i checks if a dump on either
> a dasd volume or single tape is valid.
> If the tape is part of a multi-volume tape dump,
> it checks if it is a valid portion of the dump.

Dump device: /dev/dasdb1


>>>  Dump header information  <<<
Dump created on: Mon Jul  5 16:53:40 2004

Magic number:    0xa8190173618f23fd
Version number:  2
Header size:     4096
Page size:       4096
Physical memory: 268435456
Number of pages: 65536
cpu id:          0xff20000620640000
System Arch:     s390 (ESA)
Build Arch:      s390x (ESAME)
>>>  End of Dump header  <<<


Dump ended on:   Mon Jul  5 16:54:06 2004

Dump End Marker found: this dump is valid.
```

### Checking whether a device contains a valid dump record

Checking DASD device /dev/dasda, which is a valid dump device:

```
# zgetdump -d /dev/dasda
'/dev/dasda' is Version 1 s390x (ESAME) dump device.
```

Checking DASD device `/dev/dasdc`, which is not a valid dump device:

```
# zgetdump -d /dev/dasdc
'/dev/dasdc' is no dump device.
```

## The dumpconf tool

The **dumpconf** tool configures a dump device that is used for automatic dump in case of a kernel panic. The command can be installed as service script under `/etc/init.d/dumpconf` or can be called manually. It reads the configuration file `/etc/sysconfig/dumpconf`.

**Before you start:** You need root permissions.

### dumpconf syntax

```
►►─dumpconf──┬─start──┬──────────────────────────────────────────►◄
             ├─stop───┤
             └─status─┘
```

Where:

**start** Enable configuration defined in `/etc/sysconfig/dumpconf`

**stop** Disable dump on panic.

**status** Show current configuration status of dump on panic.

**-h or --help**
Display short usage text on console. To view the man page, enter man dumpconf.

**-v or --version**
Display version number on console and exit.

## Keywords for the configuration file

**VMCMD_<*X*>**
Specifies a CP command, <*X*> is a number from one to five. You can specify up to five CP commands that are executed in case of a kernel panic. Note that VM commands, device adresses, and VM guest names must be uppercase.

**ON_PANIC**
Shutdown action in case of a kernel panic. Possible values are

- dump
- reipl
- vmcmd
- stop (default)

**DUMP_TYPE**
Type of dump device. Possible values are `ccw` and `fcp`.

**DEVICE**
Device number of dump device.

**WWPN**
WWPN for SCSI dump device.

**LUN** LUN for SCSI dump device.

**BOOTPROG**
Boot program selector

**BR_LBA**
Boot record logical block address.

## Examples

**Example configuration files for dumpconf:**

- Example configuration for CCW dump device (DASD):

```
ON_PANIC=dump
DUMP_TYPE=ccw
DEVICE=0.0.4714
```

- Example configuration for FCP dump device (SCSI disk):

```
ON_PANIC=dump
DUMP_TYPE=fcp
DEVICE=0.0.4711
WWPN=0x5005076303004712
LUN=0x4713000000000000
BOOTPROG=0
BR_LBA=0
```

- Example configuration for re-IPL on panic

```
ON_PANIC=reipl
```

- Example of sending a message to guest ″MASTER″, executing a CP VMDUMP command, and reboot from device 4711 in case of a kernel panic:

```
ON_PANIC=vmcmd
VMCMD_1="MSG MASTER Starting VMDUMP"
VMCMD_2="VMDUMP"
VMCMD_3="IPL 4711"
```

Note that VM commands, device adresses, and VM guest names must be uppercase.

**Examples of dumpconf use:** Use dumpconf to enable and disable the configuration.

- To enable the configuration:

```
> dumpconf start
ccw dump device configured. "dump" on panic configured.
```

- To display the status:

```
> dumpconf status
type....: ccw
device..: 0.0.4714
on_panic: dump
```

- To disable dump on panic:

```
> dumpconf stop
Dump on panic is disabled now
```

- To display the status again and check that the status is now stopped.

```
> dumpconf status
type....: no dump device configured
on_panic: stop
```

If the dumpconf script is installed under `/etc/init.d`, **dumpconf** can be called with the service utility. For example, `service dumpconf start`.

## The crash tool

The **crash** tool is a GPL-licensed tool maintained by Red Hat. For more details see the tool online help.

## The lcrash tool

The lcrash tool is maintained within the LKCD project. See the documentation at `http://lkcd.sourceforge.net` and the man page for further information.

## The vmconvert tool

The vmconvert tool converts a dump that was created with VMDUMP into a that can be analyzed with lcrash or **crash**.

**vmconvert syntax**

```
►►─vmconvert──┬─ -f <vmdump_file>──┬─ -o dump.lkcd──────┬──────────────────►◄
              │                    └─ -o <output_file>──┘
              │
              ├─ <vmdump_file>──┬─ dump.lkcd──────┬──────────────────────────
              │                 └─ <output_file>──┘
              │
              ├─ -v──────────────────────────────────────────────────────────
              │
              └─ -h──────────────────────────────────────────────────────────
```

Where:

*<vmdump_file>* **or -f** *<vmdump_file>* **or --file** *<vmdump_file>*
: specifies the VMDUMP created dump file to be converted.

*<output_file>* **or -o** *<output_file>* **or --output** *<output_file>*
: specifies the name of the dump file to be created. The default is dump.lkcd.

**-v or --version**
: displays the tool version.

**-h or --help**
: displays the help information for the command.

## Example

To convert a VMDUMP-created dump file “vmdump1” into a dump file “dump1.lkcd” that can be processed with lcrash or **crash** issue:

```
# vmconvert -f vmdump1 -o dump1.lkcd
```

You can also use positional parameters:

```
# vmconvert vm.dump lkcd.dump
vmdump information:
  architecture: 32 bit
  date........: Fri Feb 18 11:06:45 2005
  storage.....: 16 MB
  cpus........: 6
   16 of 16 |##################################################| 100%

'lkcd.dump' has been written successfully.
```

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