# Installation, Configuration and Management of zram on SLES

`zram` is a Linux kernel module that creates compressed block devices in RAM for use as swap space or RAM disks on SUSE Linux Enterprise Server. By dynamically compressing data in memory, zram delivers fast I/O operations and reduces memory usage, making it an efficient solution for optimizing performance and maximizing available memory in resource-constrained environments.

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# 1 What is zram?

zram is a kernel module that creates a compressed block device in RAM. The block device can be used as a RAM disk (usually to store temporary files) or for swap.

## 1.1 Benefits of zram

Using zram can have the following benefits:

- *Fast I/O operations* — due to the RAM-based nature of zram, block devices provide very fast access to data.
- *Memory savings* — as the data is compressed using zram, a decent amount of memory can be saved. Thus, zram uses RAM efficiently and is particularly suitable in environments with low RAM size, for example, embedded systems.
- *File system on the block device* — you can create file systems on the block devices.

## 1.2 Limitations of zram

Hibernation to zram swap is not supported even if you configure a backing device on permanent storage.

# 2 Setting up zram

To properly set up zram on your system, perform the following steps. Details are provided in the subsequent sections.

1. Install the `zram-generator` utility that creates the RAM block device according to the provided configuration. For details on the installation, refer to *Section 2.1, "Installing zram packages"*.
2. Prepare the configuration as described in *Section 2.2, "Configuration needed for zram"*.
3. Run commands to create new device units as described in *Section 2.3, "Creating device units"*.
4. Reboot your machine.
5. Verify that everything works correctly. Run the **`zramctl`** command, which should produce an output similar to the following:

```
> sudo zramctl
```

```
NAME       ALGORITHM DISKSIZE DATA COMPR TOTAL STREAMS MOUNTPOINT
/dev/zram1 lzo-rle      96.6M   4K   79B   12K       1 [SWAP]
/dev/zram0 lzo-rle       483M   4K   79B   12K       1 [SWAP]
```

## 2.1 Installing zram packages

The package `zram-generator` is not available by default on SUSE Linux Enterprise Server. Install the package as follows:

```
> sudo transactional-update pkg install zram-generator
```

After successful installation, reboot the system.

## 2.2 Configuration needed for zram

The main configuration file of zram is `/etc/systemd/zram-generator.conf`. However, you can create a directory `/etc/systemd/zram-generator.conf.d/` with a set of drop-in files that can override entries in the main configuration file.

### 2.2.1 The `/etc/systemd/zram-generator.conf` file

The file is not installed along with the `zram-generator` package, so you need to write your own. Options to add are described below. An example is provided in *Section 2.2.1.1, "An example of `/etc/systemd/zram-generator.conf`"*.

Define at least one zram device. Numbering starts at 0, so to define one zram device, add a `[zram0]` section to the configuration file.

You can define the following entries under the zram device section:

**host-memory-limit**

Specify the maximum RAM size of the host in MiB when a block device can be created. If the value is higher, the zram device will not be created. If not set or set to `none`, there is no limit to the host RAM.

### zram-size

Specify the size of the zram device as compared to the host RAM. The default value is `zram-size = min(ram / 10, RAM_HARD_LIMIT)`. It is a minimum of either, where `ram` is the host RAM size obtained using **`MemTotal`**.

- `ram` is the total amount of the host memory in MB.
- `ram/10` – is the ratio of total host memory that can be used for zram. According to the example, zram can use 10% of the total host memory. We recommend fractions of the host RAM in the range 10 – 50%.
- *`RAM_HARD_LIMIT`* is the maximum amount of RAM in MB that can be used by zram.
- `min()` is a function that compares the value of *`RAM_HARD_LIMIT`* and the calculated ratio and selects the lower one.

### compression-algorithm

Specify the algorithm used to compress data in zram. You can use any of the following values:

- `deflate` — a lossless data compression file format
- `lz4` or `lz4hc` — a lossless data compression algorithm that is focused on compression and decompression speed
- `lzo-rle` — a lossless data compression algorithm that is focused on decompression speed
- `zstd` aka Zstandard — a lossless data compression algorithm comparable to DEFLATE with the compression ratio but faster during decompression
- `842` — a data compression algorithm

If omitted, the kernel default is used (usually LZO-RLE).

### options

Specify options for swap or mount options for a RAM disk. If set to `discard` or omitted, the unused compressed pages are trimmed during the system run. Such a solution provides efficient zram management. To override the default (`discard`), leave the value empty:

```
options =
```

### writeback-device

Specify a device where to store incompressible pages. These pages are then removed from zram.

**fs-type**

If the device is used as a disk, specify the file system to be used there. For example, `ext4`.

**mount-point**

Specify a directory where to mount the file system. This option is not used when the zram device is used for swap.

#### 2.2.1.1 An example of `/etc/systemd/zram-generator.conf`

The following example creates two block devices in RAM — `zram0` for swap and `zram1` with the ext4 file system. If the machine has over 9 GB of RAM, `zram0` will not be created. Each block device will allocate up to 2 GB of RAM.

```
[zram0]
host-memory-limit = 9048
zram-size = min(ram / 10, 2048)
compression-algorithm = lzo-rle
options = discard
writeback-device = /dev/zvol/tarta-zoot/swap-writeback

[zram1]
zram-size = ram / 10
fs-type = ext4
mount-point = /run/compressed-mount-point
```

## 2.3 Creating device units

After you prepare the configuration, create and start the devices. To do this, see the procedure below:

1. Create the zram device units by running the command:

   ```
   > sudo systemctl daemon-reload
   ```

2. Start the device:

   ```
   > sudo systemctl start DEVICE_NAME
   DEVICE_NAME is the name you configured in
   /etc/systemd/zram-generator.conf and it is in the format /dev/zramN
   ```

3. To verify that modules were started, run the following command for each device:

   ```
   > sudo systemctl status DEVICE_NAME
   ```

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