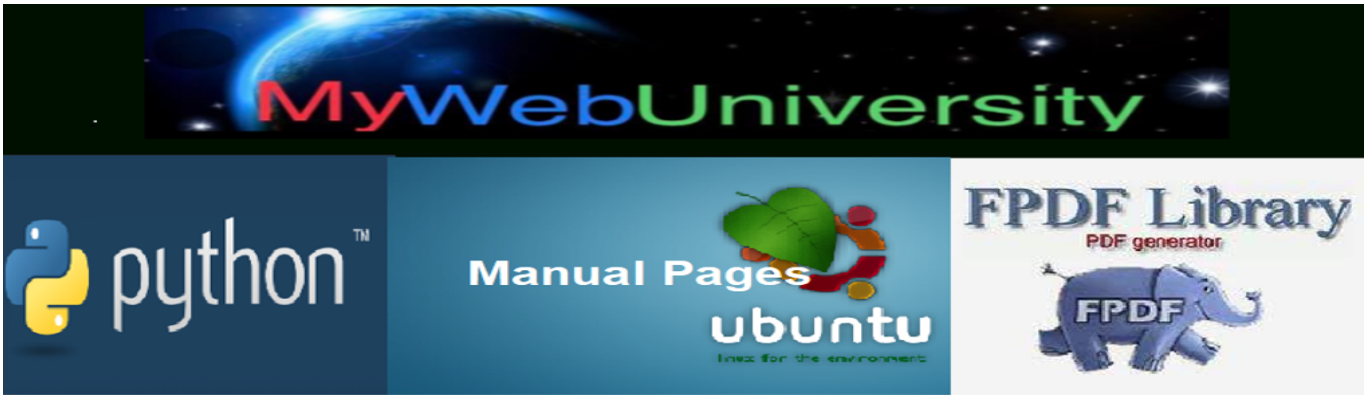

Rocky Enterprise Linux 9.2 Manual Pages on command 'mremap.2'

$ man mremap.2

MREMAP(2) Linux Programmer's Manual MREMAP(2)

NAME

mremap - remap a virtual memory address

SYNOPSIS

```
#define _GNU_SOURCE         /* See feature_test_macros(7) */
#include <sys/mman.h>
void *mremap(void *old_address, size_t old_size,
             size_t new_size, int flags, ... /* void *new_address */);
```

DESCRIPTION

mremap() expands (or shrinks) an existing memory mapping, potentially moving it at the same time (controlled by the flags argument and the available virtual address space).

old_address is the old address of the virtual memory block that you want to expand (or shrink). Note that old_address has to be page aligned. old_size is the old size of the virtual memory block. new_size is the requested size of the virtual memory block after the resize. An optional fifth argument, new_address, may be provided; see the description of MREMAP_FIXED below.

If the value of old_size is zero, and old_address refers to a shareable mapping (see mmap(2) MAP_SHARED), then mremap() will create a new mapping of the same pages. new_size will be the size of the new mapping and the location of the new mapping may be specified with new_address; see the description of MREMAP_FIXED below. If a new mapping is re? quested via this method, then the MREMAP_MAYMOVE flag must also be specified.

The flags bit-mask argument may be 0, or include the following flags:

MREMAP_MAYMOVE

By default, if there is not sufficient space to expand a mapping at its current lo?
cation, then mremap() fails. If this flag is specified, then the kernel is permit?
ted to relocate the mapping to a new virtual address, if necessary. If the mapping
is relocated, then absolute pointers into the old mapping location become invalid
(offsets relative to the starting address of the mapping should be employed).

MREMAP_FIXED (since Linux 2.3.31)

This flag serves a similar purpose to the MAP_FIXED flag of mmap(2). If this flag
is specified, then mremap() accepts a fifth argument, void *new_address, which
specifies a page-aligned address to which the mapping must be moved. Any previous
mapping at the address range specified by new_address and new_size is unmapped.
If MREMAP_FIXED is specified, then MREMAP_MAYMOVE must also be specified.

MREMAP_DONTUNMAP (since Linux 5.7)

This flag, which must be used in conjunction with MREMAP_MAYMOVE, remaps a mapping
to a new address but does not unmap the mapping at old_address.
The MREMAP_DONTUNMAP flag can be used only with private anonymous mappings (see the
description of MAP_PRIVATE and MAP_ANONYMOUS in mmap(2)).
After completion, any access to the range specified by old_address and old_size
will result in a page fault. The page fault will be handled by a userfaultfd(2)
handler if the address is in a range previously registered with userfaultfd(2).
Otherwise, the kernel allocates a zero-filled page to handle the fault.
The MREMAP_DONTUNMAP flag may be used to atomically move a mapping while leaving
the source mapped. See NOTES for some possible applications of MREMAP_DONTUNMAP.

If the memory segment specified by old_address and old_size is locked (using mlock(2) or
similar), then this lock is maintained when the segment is resized and/or relocated. As a
consequence, the amount of memory locked by the process may change.

RETURN VALUE

On success mremap() returns a pointer to the new virtual memory area. On error, the value
MAP_FAILED (that is, (void *) -1) is returned, and errno is set appropriately.

ERRORS

EAGAIN The caller tried to expand a memory segment that is locked, but this was not possi?
ble without exceeding the RLIMIT_MEMLOCK resource limit.

EFAULT Some address in the range old_address to old_address+old_size is an invalid virtual
memory address for this process. You can also get EFAULT even if there exist map?

pings that cover the whole address space requested, but those mappings are of dif?
ferent types.

EINVAL An invalid argument was given. Possible causes are:

* old_address was not page aligned;
* a value other than MREMAP_MAYMOVE or MREMAP_FIXED or MREMAP_DONTUNMAP was speci?
fied in flags;
* new_size was zero;
* new_size or new_address was invalid;
* the new address range specified by new_address and new_size overlapped the old
address range specified by old_address and old_size;
* MREMAP_FIXED or MREMAP_DONTUNMAP was specified without also specifying
MREMAP_MAYMOVE;
* MREMAP_DONTUNMAP was specified, but one or more pages in the range specified by
old_address and old_size were not private anonymous;
* MREMAP_DONTUNMAP was specified and old_size was not equal to new_size;
* old_size was zero and old_address does not refer to a shareable mapping (but see
BUGS);
* old_size was zero and the MREMAP_MAYMOVE flag was not specified.

ENOMEM Not enough memory was available to complete the operation. Possible causes are:

* The memory area cannot be expanded at the current virtual address, and the
MREMAP_MAYMOVE flag is not set in flags. Or, there is not enough (virtual) mem?
ory available.
* MREMAP_DONTUNMAP was used causing a new mapping to be created that would exceed
the (virtual) memory available. Or, it would exceed the maximum number of al?
lowed mappings.

CONFORMING TO

This call is Linux-specific, and should not be used in programs intended to be portable.

NOTES

mremap() changes the mapping between virtual addresses and memory pages. This can be used
to implement a very efficient realloc(3).

In Linux, memory is divided into pages. A process has (one or) several linear virtual
memory segments. Each virtual memory segment has one or more mappings to real memory
pages (in the page table). Each virtual memory segment has its own protection (access

rights), which may cause a segmentation violation (SIGSEGV) if the memory is accessed in? correctly (e.g., writing to a read-only segment). Accessing virtual memory outside of the segments will also cause a segmentation violation.

If mremap() is used to move or expand an area locked with mlock(2) or equivalent, the mremap() call will make a best effort to populate the new area but will not fail with ENOMEM if the area cannot be populated.

Prior to version 2.4, glibc did not expose the definition of MREMAP_FIXED, and the proto? type for mremap() did not allow for the new_address argument.

MREMAP_DONTUNMAP use cases

Possible applications for MREMAP_DONTUNMAP include:

* Non-cooperative userfaultfd(2): an application can yank out a virtual address range us? ing MREMAP_DONTUNMAP and then employ a userfaultfd(2) handler to handle the page faults that subsequently occur as other threads in the process touch pages in the yanked range.

* Garbage collection: MREMAP_DONTUNMAP can be used in conjunction with userfaultfd(2) to implement garbage collection algorithms (e.g., in a Java virtual machine). Such an im? plementation can be cheaper (and simpler) than conventional garbage collection tech? niques that involve marking pages with protection PROT_NONE in conjunction with the of a SIGSEGV handler to catch accesses to those pages.

BUGS

Before Linux 4.14, if old_size was zero and the mapping referred to by old_address was a private mapping (mmap(2) MAP_PRIVATE), mremap() created a new private mapping unrelated to the original mapping. This behavior was unintended and probably unexpected in user-space applications (since the intention of mremap() is to create a new mapping based on the original mapping). Since Linux 4.14, mremap() fails with the error EINVAL in this sce? nario.

SEE ALSO

brk(2), getpagesize(2), getrlimit(2), mlock(2), mmap(2), sbrk(2), malloc(3), realloc(3)

Your favorite text book on operating systems for more information on paged memory (e.g., Modern Operating Systems by Andrew S. Tanenbaum, Inside Linux by Randolph Bentson, The De? sign of the UNIX Operating System by Maurice J. Bach)

COLOPHON

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