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Red Hat Enterprise Linux Release 9.2 Manual Pages on 'mremap.2' command

$ 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 map? ping 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 location, then mremap() fails. If this flag is specified, then the kernel is permitted to relocate the mapping to a new virtual address, if necessary. If the mapping is relo? cated, then absolute pointers into the old mapping location be? come 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 previ? ous 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_MAY? MOVE, 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 anony? mous mappings (see the description of MAP_PRIVATE and MAP_ANONY? MOUS in mmap(2)).

After completion, any access to the range specified by old_ad? dress 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 map?

ping while leaving the source mapped. See NOTES for some possi?
ble 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 seg? ment is resized and/or relocated. As a consequence, the amount of mem? ory 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 possible without exceeding the RLIMIT_MEMLOCK re? source 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 mappings that cover the whole address space requested, but those mappings are of differ? ent 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 specified 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 share? able mapping (but see BUGS);

* old_size was zero and the MREMAP_MAYMOVE flag was not speci? fied.

ENOMEM Not enough memory was available to complete the operation. Pos? sible causes are:

* The memory area cannot be expanded at the current virtual ad? dress, and the MREMAP_MAYMOVE flag is not set in flags. Or, there is not enough (virtual) memory 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 allowed mappings.

CONFORMING TO

This call is Linux-specific, and should not be used in programs in? tended 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 incor? rectly (e.g., writing to a read-only segment). Accessing virtual mem? ory 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 prototype 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 vir?
  tual address range using MREMAP_DONTUNMAP and then employ a user?
  faultfd(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 implementation can be cheaper (and
  simpler) than conventional garbage collection techniques that in?
  volve 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() cre? ated a new private mapping unrelated to the original mapping. This be? havior was unintended and probably unexpected in user-space applica? tions (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 scenario.

SEE ALSO

brk(2), getpagesize(2), getrlimit(2), mlock(2), mmap(2), sbrk(2), mal? loc(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 Design of the UNIX Operating Sys? tem by Maurice J. Bach)

COLOPHON

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