

**NAME**

**make\_dev, make\_dev\_cred, make\_dev\_credf, make\_dev\_p, make\_dev\_s, make\_dev\_alias, make\_dev\_alias\_p, destroy\_dev, destroy\_dev\_sched, destroy\_dev\_sched\_cb, destroy\_dev\_drain, dev\_depends** - manage *cdev*'s and DEVFS registration for devices

**SYNOPSIS**

```
#include <sys/param.h>
```

```
#include <sys/conf.h>
```

*void*

```
make_dev_args_init(struct make_dev_args *args);
```

*int*

```
make_dev_s(struct make_dev_args *args, struct cdev **cdev, const char *fmt, ...);
```

*int*

```
make_dev_alias_p(int flags, struct cdev **cdev, struct cdev *pdev, const char *fmt, ...);
```

*void*

```
destroy_dev(struct cdev *dev);
```

*void*

```
destroy_dev_sched(struct cdev *dev);
```

*void*

```
destroy_dev_sched_cb(struct cdev *dev, void (*cb)(void *), void *arg);
```

*void*

```
destroy_dev_drain(struct cdevsw *csw);
```

*void*

```
dev_depends(struct cdev *pdev, struct cdev *cdev);
```

**LEGACY INTERFACES**

*struct cdev \**

```
make_dev(struct cdevsw *cdevsw, int unit, uid_t uid, gid_t gid, int perms, const char *fmt, ...);
```

*struct cdev \**

```
make_dev_cred(struct cdevsw *cdevsw, int unit, struct ucred *cr, uid_t uid, gid_t gid, int perms, const char *fmt, ...);
```

*struct cdev \**

**make\_dev\_credf**(*int flags, struct cdevsw \*cdevsw, int unit, struct ucred \*cr, uid\_t uid, gid\_t gid, int perms, const char \*fmt, ...*);

*int*

**make\_dev\_p**(*int flags, struct cdev \*\*cdev, struct cdevsw \*devsw, struct ucred \*cr, uid\_t uid, gid\_t gid, int mode, const char \*fmt, ...*);

*struct cdev \**

**make\_dev\_alias**(*struct cdev \*pdev, const char \*fmt, ...*);

## DESCRIPTION

The **make\_dev\_s**(*s*) function creates a *cdev* structure for a new device, which is returned into the *cdev* argument. It also notifies *devfs*(5) of the presence of the new device, that causes corresponding nodes to be created. Besides this, a *devctl*(4) notification is sent. The function takes the structure *struct make\_dev\_args*, which specifies the parameters for the device creation:

```
struct make_dev_args {
    size_t          mda_size;
    int             mda_flags;
    struct cdevsw   *mda_devsw;
    struct ucred    *mda_cr;
    uid_t           mda_uid;
    gid_t           mda_gid;
    int             mda_mode;
    int             mda_unit;
    void            *mda_si_drv1;
    void            *mda_si_drv2;
};
```

Before use and filling with the desired values, the structure must be initialized by the **make\_dev\_args\_init**(*i*) function, which ensures that future kernel interface expansion does not affect driver source code or binary interface.

The created device will be owned by *args.mda\_uid*, with the group ownership as *args.mda\_gid*. The name is the expansion of *fmt* and following arguments as *printf*(9) would print it. The name determines its path under */dev* or other *devfs*(5) mount point and may contain slash *'/'* characters to denote subdirectories. The permissions of the file specified in *args.mda\_mode* are defined in *<sys/stat.h>*:

```
#define S_IRWXU 0000700 /* RWX mask for owner */
#define S_IRUSR 0000400 /* R for owner */
```

```

#define S_IWUSR 0000200 /* W for owner */
#define S_IXUSR 0000100 /* X for owner */

#define S_IRWXG 0000070 /* RWX mask for group */
#define S_IRGRP 0000040 /* R for group */
#define S_IWGRP 0000020 /* W for group */
#define S_IXGRP 0000010 /* X for group */

#define S_IRWXO 0000007 /* RWX mask for other */
#define S_IROTH 0000004 /* R for other */
#define S_IWOTH 0000002 /* W for other */
#define S_IXOTH 0000001 /* X for other */

#define S_ISUID 0004000 /* set user id on execution */
#define S_ISGID 0002000 /* set group id on execution */
#define S_ISVTX 0001000 /* sticky bit */
#ifdef _POSIX_SOURCE
#define S_ISTXT 0001000
#endif

```

The *args.mda\_cr* argument specifies credentials that will be stored in the *si\_cred* member of the initialized *struct cdev*.

The *args.mda\_flags* argument alters the operation of **make\_dev\_s()** The following values are currently accepted:

MAKEDEV_REF	reference the created device
MAKEDEV_NOWAIT	do not sleep, the call may fail
MAKEDEV_WAITOK	allow the function to sleep to satisfy malloc
MAKEDEV_ETERNAL	created device will be never destroyed
MAKEDEV_CHECKNAME	return an error if the device name is invalid or already exists

Only MAKEDEV\_NOWAIT, MAKEDEV\_WAITOK and MAKEDEV\_CHECKNAME values are accepted for the **make\_dev\_alias\_p()** function.

The MAKEDEV\_WAITOK flag is assumed if none of MAKEDEV\_WAITOK, MAKEDEV\_NOWAIT is specified.

The dev\_clone(9) event handler shall specify MAKEDEV\_REF flag when creating a device in response to lookup, to avoid race where the device created is destroyed immediately after devfs\_lookup(9) drops

his reference to `cdev`.

The `MAKEDEV_ETERNAL` flag allows the kernel to not acquire some locks when translating system calls into the `cdevsw` methods calls. It is responsibility of the driver author to make sure that `destroy_dev()` is never called on the returned `cdev`. For the convenience, use the `MAKEDEV_ETERNAL_KLD` flag for the code that can be compiled into kernel or loaded (and unloaded) as loadable module.

A panic will occur if the `MAKEDEV_CHECKNAME` flag is not specified and the device name is invalid or already exists.

The `make_dev_p()` use of the form

```
struct cdev *dev;
int res;
res = make_dev_p(flags, &dev, cdevsw, cred, uid, gid, perms, name);
```

is equivalent to the code

```
struct cdev *dev;
struct make_dev_args args;
int res;

make_dev_args_init(&args);
args.mda_flags = flags;
args.mda_devsw = cdevsw;
args.mda_cred = cred;
args.mda_uid = uid;
args.mda_gid = gid;
args.mda_mode = perms;
res = make_dev_s(&args, &dev, name);
```

Similarly, the `make_dev_credf()` function call is equivalent to

```
(void) make_dev_s(&args, &dev, name);
```

In other words, `make_dev_credf()` does not allow the caller to obtain the return value, and in kernels compiled with the `INVARIANTS` options, the function asserts that the device creation succeeded.

The `make_dev_cred()` function is equivalent to the call

```
make_dev_credf(0, cdevsw, unit, cr, uid, gid, perms, fmt, ...);
```

The **make\_dev()** function call is the same as

```
make_dev_credf(0, cdevsw, unit, NULL, uid, gid, perms, fmt, ...);
```

The **make\_dev\_alias\_p()** function takes the returned *cdev* from **make\_dev()** and makes another (aliased) name for this device. It is an error to call **make\_dev\_alias\_p()** prior to calling **make\_dev()**.

The **make\_dev\_alias()** function is similar to **make\_dev\_alias\_p()** but it returns the resulting aliasing *\*cdev* and may not return an error.

The *cdev* returned by **make\_dev\_s()** and **make\_dev\_alias\_p()** has two fields, *si\_drv1* and *si\_drv2*, that are available to store state. Both fields are of type *void \**, and can be initialized simultaneously with the *cdev* allocation by filling *args.mda\_si\_drv1* and *args.mda\_si\_drv2* members of the **make\_dev\_s()** argument structure, or filled after the *cdev* is allocated, if using legacy interfaces. In the latter case, the driver should handle the race of accessing uninitialized *si\_drv1* and *si\_drv2* itself. These are designed to replace the *unit* argument to **make\_dev()**, which can be obtained with **dev2unit()**.

The **destroy\_dev()** function takes the returned *cdev* from **make\_dev()** and destroys the registration for that device. The notification is sent to devctl(4) about the destruction event. Do not call **destroy\_dev()** on devices that were created with **make\_dev\_alias()**.

The **dev\_depends()** function establishes a parent-child relationship between two devices. The net effect is that a **destroy\_dev()** of the parent device will also result in the destruction of the child device(s), if any exist. A device may simultaneously be a parent and a child, so it is possible to build a complete hierarchy.

The **destroy\_dev\_sched\_cb()** function schedules execution of the **destroy\_dev()** for the specified *cdev* in the safe context. After **destroy\_dev()** is finished, and if the supplied *cb* is not NULL, the callback *cb* is called, with argument *arg*. The **destroy\_dev\_sched()** function is the same as

```
destroy_dev_sched_cb(cdev, NULL, NULL);
```

The **d\_close()** driver method cannot call **destroy\_dev()** directly. Doing so causes deadlock when **destroy\_dev()** waits for all threads to leave the driver methods. Also, because **destroy\_dev()** sleeps, no non-sleepable locks may be held over the call. The **destroy\_dev\_sched()** family of functions overcome these issues.

The device driver may call the **destroy\_dev\_drain()** function to wait until all devices that have supplied *csw* as *cdevsw*, are destroyed. This is useful when driver knows that **destroy\_dev\_sched()** is called for all instantiated devices, but need to postpone module unload until **destroy\_dev()** is actually finished for

all of them.

## RETURN VALUES

If successful, **make\_dev\_s()** and **make\_dev\_p()** will return 0, otherwise they will return an error. If successful, **make\_dev\_credf()** will return a valid *cdev* pointer, otherwise it will return NULL.

## ERRORS

The **make\_dev\_s()**, **make\_dev\_p()** and **make\_dev\_alias\_p()** calls will fail and the device will be not registered if:

[ENOMEM]           The MAKEDEV\_NOWAIT flag was specified and a memory allocation request could not be satisfied.

[ENAMETOOLONG]     The MAKEDEV\_CHECKNAME flag was specified and the provided device name is longer than SPECNAMELEN.

[EINVAL]            The MAKEDEV\_CHECKNAME flag was specified and the provided device name is empty, contains a "." or ".." path component or ends with '/'.

[EINVAL]            The MAKEDEV\_CHECKNAME flag was specified and the provided device name contains invalid characters.

[EEXIST]            The MAKEDEV\_CHECKNAME flag was specified and the provided device name already exists.

## SEE ALSO

devctl(4), devfs(5), dev\_clone(9)

## HISTORY

The **make\_dev()** and **destroy\_dev()** functions first appeared in FreeBSD 4.0. The function **make\_dev\_alias()** first appeared in FreeBSD 4.1. The function **dev\_depends()** first appeared in FreeBSD 5.0. The functions **make\_dev\_credf()**, **destroy\_dev\_sched()**, **destroy\_dev\_sched\_cb()** first appeared in FreeBSD 7.0. The function **make\_dev\_p()** first appeared in FreeBSD 8.2. The function **make\_dev\_s()** first appeared in FreeBSD 11.0.