

**NAME**

**sglist**, **sglist\_alloc**, **sglist\_append**, **sglist\_append\_bio**, **sglist\_append\_mbuf**, **sglist\_append\_mbuf\_epg**, **sglist\_append\_phys**, **sglist\_append\_sglist**, **sglist\_append\_single\_mbuf**, **sglist\_append\_uio**, **sglist\_append\_user**, **sglist\_append\_vmpages**, **sglist\_build**, **sglist\_clone**, **sglist\_consume\_uio**, **sglist\_count**, **sglist\_count\_mbuf\_epg**, **sglist\_count\_vmpages**, **sglist\_free**, **sglist\_hold**, **sglist\_init**, **sglist\_join**, **sglist\_length**, **sglist\_reset**, **sglist\_slice**, **sglist\_split** - manage a scatter/gather list of physical memory addresses

**SYNOPSIS**

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

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

```
struct sglist *
```

```
sglist_alloc(int nsegs, int mflags);
```

```
int
```

```
sglist_append(struct sglist *sg, void *buf, size_t len);
```

```
int
```

```
sglist_append_bio(struct sglist *sg, struct bio *bp);
```

```
int
```

```
sglist_append_mbuf_epg(struct sglist *sg, struct mbuf *m, size_t offset, size_t len);
```

```
int
```

```
sglist_append_mbuf(struct sglist *sg, struct mbuf *m);
```

```
int
```

```
sglist_append_phys(struct sglist *sg, vm_paddr_t paddr, size_t len);
```

```
int
```

```
sglist_append_sglist(struct sglist *sg, struct sglist *source, size_t offset, size_t len);
```

```
int
```

```
sglist_append_single_mbuf(struct sglist *sg, struct mbuf *m);
```

```
int
```

```
sglist_append_uio(struct sglist *sg, struct uio *uio);
```

```
int
```

**sglist\_append\_user**(*struct sgl* \*sg, *void \*buf*, *size\_t len*, *struct thread \*td*);

*int*

**sglist\_append\_vmpages**(*struct sgl* \*sg, *vm\_page\_t \*m*, *size\_t pgoff*, *size\_t len*);

*struct sgl* \*

**sglist\_build**(*void \*buf*, *size\_t len*, *int mflags*);

*struct sgl* \*

**sglist\_clone**(*struct sgl* \*sg, *int mflags*);

*int*

**sglist\_consume\_uio**(*struct sgl* \*sg, *struct uio \*uio*, *size\_t resid*);

*int*

**sglist\_count**(*void \*buf*, *size\_t len*);

*int*

**sglist\_count\_mbuf\_epg**(*struct mbuf \*m*, *size\_t offset*, *size\_t len*);

*int*

**sglist\_count\_vmpages**(*vm\_page\_t \*m*, *size\_t pgoff*, *size\_t len*);

*void*

**sglist\_free**(*struct sgl* \*sg);

*struct sgl* \*

**sglist\_hold**(*struct sgl* \*sg);

*void*

**sglist\_init**(*struct sgl* \*sg, *int maxsegs*, *struct sgl\_seg \*segs*);

*int*

**sglist\_join**(*struct sgl* \*first, *struct sgl* \*second);

*size\_t*

**sglist\_length**(*struct sgl* \*sg);

*void*

**sglist\_reset**(*struct sgl* \*sg);

*int*

**sglist\_slice**(*struct sglst \*original, struct sglst \*\*slice, size\_t offset, size\_t length, int mflags*);

*int*

**sglist\_split**(*struct sglst \*original, struct sglst \*\*head, size\_t length, int mflags*);

## DESCRIPTION

The **sglist** API manages physical address ranges. Each list contains one or more elements. Each element contains a starting physical address and a length. Scatter/gather lists are read-only while they are shared. If one wishes to alter an existing scatter/gather list and does not hold the sole reference to the list, then one should create a new list instead of modifying the existing list.

Each scatter/gather list object contains a reference count. New lists are created with a single reference. New references are obtained by calling **sglist\_hold** and are released by calling **sglist\_free**.

### Allocating and Initializing Lists

Each **sglist** object consists of a header structure and a variable-length array of scatter/gather list elements. The **sglist\_alloc** function allocates a new list that contains a header and *nsegs* scatter/gather list elements. The *mflags* argument can be set to either `M_NOWAIT` or `M_WAITOK`.

The **sglist\_count** function returns the number of scatter/gather list elements needed to describe the physical address ranges mapped by a single kernel virtual address range. The kernel virtual address range starts at *buf* and is *len* bytes long.

The **sglist\_count\_mbuf\_epg** function returns the number of scatter/gather list elements needed to describe the external multipage mbuf buffer *m*. The ranges start at an offset of *offset* relative to the start of the buffer and is *len* bytes long.

The **sglist\_count\_vmpages** function returns the number of scatter/gather list elements needed to describe the physical address ranges of a buffer backed by an array of virtual memory pages *m*. The buffer starts at an offset of *pgoff* bytes relative to the first page and is *len* bytes long.

The **sglist\_build** function allocates a new scatter/gather list object that describes the physical address ranges mapped by a single kernel virtual address range. The kernel virtual address range starts at *buf* and is *len* bytes long. The *mflags* argument can be set to either `M_NOWAIT` or `M_WAITOK`.

The **sglist\_clone** function returns a copy of an existing scatter/gather list object *sg*. The *mflags* argument can be set to either `M_NOWAIT` or `M_WAITOK`. This can be used to obtain a private copy of a scatter/gather list before modifying it.

The **sglist\_init** function initializes a scatter/gather list header. The header is pointed to by *sg* and is initialized to manage an array of *maxsegs* scatter/gather list elements pointed to by *segs*. This can be used to initialize a scatter/gather list header whose storage is not provided by **sglist\_alloc**. In that case, the caller should not call **sglist\_free** to release its own reference and is responsible for ensuring all other references to the list are dropped before it releases the storage for *sg* and *segs*.

### Constructing Scatter/Gather Lists

The **sglist** API provides several routines for building a scatter/gather list to describe one or more objects. Specifically, the **sglist\_append** family of routines can be used to append the physical address ranges described by an object to the end of a scatter/gather list. All of these routines return 0 on success or an error on failure. If a request to append an address range to a scatter/gather list fails, the scatter/gather list will remain unchanged.

The **sglist\_append** function appends the physical address ranges described by a single kernel virtual address range to the scatter/gather list *sg*. The kernel virtual address range starts at *buf* and is *len* bytes long.

The **sglist\_append\_bio** function appends the physical address ranges described by a single bio *bp* to the scatter/gather list *sg*.

The **sglist\_append\_mbuf\_epg** function appends the physical address ranges described by the external multipage mbuf(9) buffer *ext\_pgs* to the scatter/gather list *sg*. The physical address ranges start at offset *offset* within *ext\_pgs* and continue for *len* bytes. Note that unlike **sglist\_append\_mbuf**, **sglist\_append\_mbuf\_epg** only adds ranges for a single mbuf, not an entire mbuf chain.

The **sglist\_append\_mbuf** function appends the physical address ranges described by an entire mbuf chain *m* to the scatter/gather list *sg*.

The **sglist\_append\_mbuf** function appends the physical address ranges described by a single mbuf *m* to the scatter/gather list *sg*.

The **sglist\_append\_phys** function appends a single physical address range to the scatter/gather list *sg*. The physical address range starts at *paddr* and is *len* bytes long.

The **sglist\_append\_sglist** function appends physical address ranges described by the scatter/gather list *source* to the scatter/gather list *sg*. The physical address ranges start at offset *offset* within *source* and continue for *len* bytes.

The **sglist\_append\_uio** function appends the physical address ranges described by a uio(9) object to the scatter/gather list *sg*. Note that it is the caller's responsibility to ensure that the pages backing the I/O

request are wired for the lifetime of *sg*. Note also that this routine does not modify *uio*.

The **sglist\_append\_user** function appends the physical address ranges described by a single user virtual address range to the scatter/gather list *sg*. The user virtual address range is relative to the address space of the thread *td*. It starts at *buf* and is *len* bytes long. Note that it is the caller's responsibility to ensure that the pages backing the user buffer are wired for the lifetime of *sg*.

The **sglist\_append\_vmpages** function appends the physical address ranges of a buffer backed by an array of virtual memory pages *m*. The buffer starts at an offset of *pgoff* bytes relative to the first page and is *len* bytes long.

The **sglist\_consume\_uio** function is a variation of **sglist\_append\_uio**. As with **sglist\_append\_uio**, it appends the physical address ranges described by *uio* to the scatter/gather list *sg*. Unlike **sglist\_append\_uio**, however, **sglist\_consume\_uio** modifies the I/O request to indicate that the appended address ranges have been processed similar to calling `uiomove(9)`. This routine will only append ranges that describe up to *resid* total bytes in length. If the available segments in the scatter/gather list are exhausted before *resid* bytes are processed, then the *uio* structure will be updated to reflect the actual number of bytes processed, and **sglist\_consume\_uio** will return zero to indicate success. In effect, this function will perform partial reads or writes. The caller can compare the *uio\_resid* member of *uio* before and after calling **sglist\_consume\_uio** to determine the actual number of bytes processed.

### Manipulating Scatter/Gather Lists

The **sglist\_join** function appends physical address ranges from the scatter/gather list *second* onto *first* and then resets *second* to an empty list. It returns zero on success or an error on failure.

The **sglist\_split** function splits an existing scatter/gather list into two lists. The first *length* bytes described by the list *original* are moved to a new list *\*head*. If *original* describes a total address range that is smaller than *length* bytes, then all of the address ranges will be moved to the new list at *\*head* and *original* will be an empty list. The caller may supply an existing scatter/gather list in *\*head*. If so, the list must be empty. Otherwise, the caller may set *\*head* to NULL in which case a new scatter/gather list will be allocated. In that case, *mflags* may be set to either `M_NOWAIT` or `M_WAITOK`. Note that since the *original* list is modified by this call, it must be a private list with no other references. The **sglist\_split** function returns zero on success or an error on failure.

The **sglist\_slice** function generates a new scatter/gather list from a sub-range of an existing scatter/gather list *original*. The sub-range to extract is specified by the *offset* and *length* parameters. The new scatter/gather list is stored in *\*slice*. As with *head* for **sglist\_join**, the caller may either provide an empty scatter/gather list, or it may set *\*slice* to NULL in which case **sglist\_slice** will allocate a new list subject to *mflags*. Unlike **sglist\_split**, **sglist\_slice** does not modify *original* and does not require it to be a private list. The **sglist\_split** function returns zero on success or an error on failure.

### Miscellaneous Routines

The **sglist\_reset** function clears the scatter/gather list *sg* so that it no longer maps any address ranges. This can allow reuse of a single scatter/gather list object for multiple requests.

The **sglist\_length** function returns the total length of the physical address ranges described by the scatter/gather list *sg*.

### RETURN VALUES

The **sglist\_alloc**, **sglist\_build**, and **sglist\_clone** functions return a new scatter/gather list on success or NULL on failure.

The **sglist\_append** family of functions and the **sglist\_consume\_uio**, **sglist\_join**, **sglist\_slice**, and **sglist\_split** functions return zero on success or an error on failure.

The **sglist\_count** family of functions return a count of scatter/gather list elements.

The **sglist\_length** function returns a count of address space described by a scatter/gather list in bytes.

### ERRORS

The **sglist\_append** functions return the following errors on failure:

[EINVAL]           The scatter/gather list has zero segments.

[EFBIG]            There are not enough available segments in the scatter/gather list to append the specified physical address ranges.

The **sglist\_consume\_uio** function returns the following error on failure:

[EINVAL]           The scatter/gather list has zero segments.

The **sglist\_join** function returns the following error on failure:

[EFBIG]            There are not enough available segments in the scatter/gather list *first* to append the physical address ranges from *second*.

The **sglist\_slice** function returns the following errors on failure:

[EINVAL]           The *original* scatter/gather list does not describe enough address space to cover the requested sub-range.

- [EINVAL] The caller-supplied scatter/gather list in *\*slice* is not empty.
- [ENOMEM] An attempt to allocate a new scatter/gather list with M\_NOWAIT set in *mflags* failed.
- [EFBIG] There are not enough available segments in the caller-supplied scatter/gather list in *\*slice* to describe the requested physical address ranges.

The **sglist\_split** function returns the following errors on failure:

- [EDOOFUS] The *original* scatter/gather list has more than one reference.
- [EINVAL] The caller-supplied scatter/gather list in *\*head* is not empty.
- [ENOMEM] An attempt to allocate a new scatter/gather list with M\_NOWAIT set in *mflags* failed.
- [EFBIG] There are not enough available segments in the caller-supplied scatter/gather list in *\*head* to describe the requested physical address ranges.

## SEE ALSO

[g\\_bio\(9\)](#), [malloc\(9\)](#), [mbuf\(9\)](#), [uio\(9\)](#)

## HISTORY

This API was first introduced in FreeBSD 8.0.