

# **Linux Networking and Network Devices APIs**

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# Linux Networking and Network Devices APIs

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# **Chapter 1. Linux Networking**

## **Networking Base Types**

## Name

enum sock\_type — Socket types

## Synopsis

```
enum sock_type {  
    SOCK_STREAM,  
    SOCK_DGRAM,  
    SOCK_RAW,  
    SOCK_RDM,  
    SOCK_SEQPACKET,  
    SOCK_DCCP,  
    SOCK_PACKET  
};
```

## Constants

SOCK_STREAM	stream (connection) socket
SOCK_DGRAM	datagram (conn.less) socket
SOCK_RAW	raw socket
SOCK_RDM	reliably-delivered message
SOCK_SEQPACKET	sequential packet socket
SOCK_DCCP	Datagram Congestion Control Protocol socket
SOCK_PACKET	linux specific way of getting packets at the dev level. For writing rarp and other similar things on the user level.

## Description

When adding some new socket type please grep ARCH\_HAS\_SOCKET\_TYPE include/asm-\*/socket.h, at least MIPS overrides this enum for binary compat reasons.

## Name

struct socket — general BSD socket

## Synopsis

```
struct socket {
    socket_state state;
    short type;
    unsigned long flags;
    struct socket_wq __rcu * wq;
    struct file * file;
    struct sock * sk;
    const struct proto_ops * ops;
};
```

## Members

state	socket state (SS_CONNECTED, etc)
type	socket type (SOCK_STREAM, etc)
flags	socket flags (SOCK_ASYNC_NOSPACE, etc)
wq	wait queue for several uses
file	File back pointer for gc
sk	internal networking protocol agnostic socket representation
ops	protocol specific socket operations

## Socket Buffer Functions

## Name

struct `skb_shared_hwtstamps` — hardware time stamps

## Synopsis

```
struct skb_shared_hwtstamps {  
    ktime_t hwtstamp;  
    ktime_t syststamp;  
};
```

## Members

<code>hwtstamp</code>	hardware time stamp transformed into duration since arbitrary point in time
<code>syststamp</code>	<code>hwtstamp</code> transformed to system time base

## Description

Software time stamps generated by `ktime_get_real` are stored in `skb->tstamp`. The relation between the different kinds of time

## stamps is as follows

`syststamp` and `tstamp` can be compared against each other in arbitrary combinations. The accuracy of a `syststamp/tstamp`/"syststamp from other device" comparison is limited by the accuracy of the transformation into system time base. This depends on the device driver and its underlying hardware.

`hwtstamps` can only be compared against other `hwtstamps` from the same device.

This structure is attached to packets as part of the `skb_shared_info`. Use `skb_hwtstamps` to get a pointer.

## Name

struct skb\_mstamp — multi resolution time stamps

## Synopsis

```
struct skb_mstamp {  
    union {unnamed_union};  
};
```

## Members

{unnamed\_union}      anonymous



## Name

`skb_mstamp_get` — get current timestamp

## Synopsis

```
void skb_mstamp_get (struct skb_mstamp * cl);
```

## Arguments

*cl* place to store timestamps

## Name

`skb_mstamp_us_delta` — compute the difference in usec between two `skb_mstamp`

## Synopsis

```
u32 skb_mstamp_us_delta (const struct skb_mstamp * t1, const struct  
skb_mstamp * t0);
```

## Arguments

*t1* pointer to newest sample

*t0* pointer to oldest sample

## Name

struct sk\_buff — socket buffer

## Synopsis

```
struct sk_buff {
    struct sk_buff * next;
    struct sk_buff * prev;
    union {unnamed_union};
    __be16 inner_protocol;
    __u16 inner_transport_header;
    __u16 inner_network_header;
    __u16 inner_mac_header;
    __u16 transport_header;
    __u16 network_header;
    __u16 mac_header;
    sk_buff_data_t tail;
    sk_buff_data_t end;
    unsigned char * head;
    unsigned char * data;
    unsigned int truesize;
    atomic_t users;
};
```

## Members

next	Next buffer in list
prev	Previous buffer in list
{unnamed_union}	anonymous
inner_protocol	Protocol (encapsulation)
inner_transport_header	Inner transport layer header (encapsulation)
inner_network_header	Network layer header (encapsulation)
inner_mac_header	Link layer header (encapsulation)
transport_header	Transport layer header
network_header	Network layer header
mac_header	Link layer header
tail	Tail pointer
end	End pointer
head	Head of buffer
data	Data head pointer
truesize	Buffer size

users

User count - see {datagram,tcp}.c

## Name

`skb_dst` — returns `skb dst_entry`

## Synopsis

```
struct dst_entry * skb_dst (const struct sk_buff * skb);
```

## Arguments

*skb* buffer

## Description

Returns `skb dst_entry`, regardless of reference taken or not.

## Name

`skb_dst_set` — sets skb dst

## Synopsis

```
void skb_dst_set (struct sk_buff * skb, struct dst_entry * dst);
```

## Arguments

*skb*    buffer

*dst*    dst entry

## Description

Sets skb dst, assuming a reference was taken on dst and should be released by `skb_dst_drop`

## Name

`skb_dst_set_noref` — sets skb dst, hopefully, without taking reference

## Synopsis

```
void skb_dst_set_noref (struct sk_buff * skb, struct dst_entry * dst);
```

## Arguments

*skb*    buffer

*dst*    dst entry

## Description

Sets skb dst, assuming a reference was not taken on dst. If dst entry is cached, we do not take reference and `dst_release` will be avoided by `refdst_drop`. If dst entry is not cached, we take reference, so that last `dst_release` can destroy the dst immediately.

## Name

`skb_dst_set_noref_force` — sets `skb` dst, without taking reference

## Synopsis

```
void skb_dst_set_noref_force (struct sk_buff * skb, struct dst_entry  
* dst);
```

## Arguments

*skb*    buffer

*dst*    dst entry

## Description

Sets `skb` dst, assuming a reference was not taken on `dst`. No reference is taken and no `dst_release` will be called. While for cached dsts deferred reclaim is a basic feature, for entries that are not cached it is caller's job to guarantee that last `dst_release` for provided `dst` happens when nobody uses it, eg. after a RCU grace period.



## Name

`skb_dst_is_noref` — Test if skb dst isn't refcounted

## Synopsis

```
bool skb_dst_is_noref (const struct sk_buff * skb);
```

## Arguments

*skb*    buffer

## Name

`skb_queue_empty` — check if a queue is empty

## Synopsis

```
int skb_queue_empty (const struct sk_buff_head * list);
```

## Arguments

*list*    queue head

## Description

Returns true if the queue is empty, false otherwise.

## Name

`skb_queue_is_last` — check if `skb` is the last entry in the queue

## Synopsis

```
bool skb_queue_is_last (const struct sk_buff_head * list, const struct  
sk_buff * skb);
```

## Arguments

*list*    queue head

*skb*     buffer

## Description

Returns true if *skb* is the last buffer on the list.

## Name

`skb_queue_is_first` — check if `skb` is the first entry in the queue

## Synopsis

```
bool skb_queue_is_first (const struct sk_buff_head * list, const struct  
sk_buff * skb);
```

## Arguments

*list*    queue head

*skb*     buffer

## Description

Returns true if *skb* is the first buffer on the list.

## Name

`skb_queue_next` — return the next packet in the queue

## Synopsis

```
struct sk_buff * skb_queue_next (const struct sk_buff_head * list, const  
struct sk_buff * skb);
```

## Arguments

*list*    queue head

*skb*    current buffer

## Description

Return the next packet in *list* after *skb*. It is only valid to call this if `skb_queue_is_last` evaluates to false.

## Name

`skb_queue_prev` — return the prev packet in the queue

## Synopsis

```
struct sk_buff * skb_queue_prev (const struct sk_buff_head * list, const  
struct sk_buff * skb);
```

## Arguments

*list*    queue head

*skb*    current buffer

## Description

Return the prev packet in *list* before *skb*. It is only valid to call this if `skb_queue_is_first` evaluates to false.

## Name

`skb_get` — reference buffer

## Synopsis

```
struct sk_buff * skb_get (struct sk_buff * skb);
```

## Arguments

*skb*    buffer to reference

## Description

Makes another reference to a socket buffer and returns a pointer to the buffer.

## Name

`skb_cloned` — is the buffer a clone

## Synopsis

```
int skb_cloned (const struct sk_buff * skb);
```

## Arguments

*skb*    buffer to check

## Description

Returns true if the buffer was generated with `skb_clone` and is one of multiple shared copies of the buffer. Cloned buffers are shared data so must not be written to under normal circumstances.



## Name

`skb_header_cloned` — is the header a clone

## Synopsis

```
int skb_header_cloned (const struct sk_buff * skb);
```

## Arguments

*skb*    buffer to check

## Description

Returns true if modifying the header part of the buffer requires the data to be copied.

## Name

`skb_header_release` — release reference to header

## Synopsis

```
void skb_header_release (struct sk_buff * skb);
```

## Arguments

*skb*    buffer to operate on

## Description

Drop a reference to the header part of the buffer. This is done by acquiring a payload reference. You must not read from the header part of `skb->data` after this.

## Name

`skb_shared` — is the buffer shared

## Synopsis

```
int skb_shared (const struct sk_buff * skb);
```

## Arguments

*skb*    buffer to check

## Description

Returns true if more than one person has a reference to this buffer.

## Name

`skb_share_check` — check if buffer is shared and if so clone it

## Synopsis

```
struct sk_buff * skb_share_check (struct sk_buff * skb, gfp_t pri);
```

## Arguments

*skb*    buffer to check

*pri*    priority for memory allocation

## Description

If the buffer is shared the buffer is cloned and the old copy drops a reference. A new clone with a single reference is returned. If the buffer is not shared the original buffer is returned. When being called from interrupt status or with spinlocks held *pri* must be `GFP_ATOMIC`.

NULL is returned on a memory allocation failure.

## Name

`skb_unshare` — make a copy of a shared buffer

## Synopsis

```
struct sk_buff * skb_unshare (struct sk_buff * skb, gfp_t pri);
```

## Arguments

*skb*    buffer to check

*pri*    priority for memory allocation

## Description

If the socket buffer is a clone then this function creates a new copy of the data, drops a reference count on the old copy and returns the new copy with the reference count at 1. If the buffer is not a clone the original buffer is returned. When called with a spinlock held or from interrupt state *pri* must be `GFP_ATOMIC`

`NULL` is returned on a memory allocation failure.

## Name

`skb_peek` — peek at the head of an `sk_buff_head`

## Synopsis

```
struct sk_buff * skb_peek (const struct sk_buff_head * list_);
```

## Arguments

*list\_* list to peek at

## Description

Peek an `sk_buff`. Unlike most other operations you **\_MUST\_** be careful with this one. A peek leaves the buffer on the list and someone else may run off with it. You must hold the appropriate locks or have a private queue to do this.

Returns `NULL` for an empty list or a pointer to the head element. The reference count is not incremented and the reference is therefore volatile. Use with caution.

## Name

`skb_peek_next` — peek skb following the given one from a queue

## Synopsis

```
struct sk_buff * skb_peek_next (struct sk_buff * skb, const struct  
sk_buff_head * list_);
```

## Arguments

*skb*      skb to start from

*list\_*    list to peek at

## Description

Returns `NULL` when the end of the list is met or a pointer to the next element. The reference count is not incremented and the reference is therefore volatile. Use with caution.

## Name

`skb_peek_tail` — peek at the tail of an `sk_buff_head`

## Synopsis

```
struct sk_buff * skb_peek_tail (const struct sk_buff_head * list_);
```

## Arguments

*list\_* list to peek at

## Description

Peek an `sk_buff`. Unlike most other operations you **\_MUST\_** be careful with this one. A peek leaves the buffer on the list and someone else may run off with it. You must hold the appropriate locks or have a private queue to do this.

Returns `NULL` for an empty list or a pointer to the tail element. The reference count is not incremented and the reference is therefore volatile. Use with caution.



## Name

`skb_queue_len` — get queue length

## Synopsis

```
__u32 skb_queue_len (const struct sk_buff_head * list_);
```

## Arguments

*list\_* list to measure

## Description

Return the length of an `sk_buff` queue.

## Name

`__skb_queue_head_init` — initialize non-spinlock portions of `sk_buff_head`

## Synopsis

```
void __skb_queue_head_init (struct sk_buff_head * list);
```

## Arguments

*list* queue to initialize

## Description

This initializes only the list and queue length aspects of an `sk_buff_head` object. This allows to initialize the list aspects of an `sk_buff_head` without reinitializing things like the spinlock. It can also be used for on-stack `sk_buff_head` objects where the spinlock is known to not be used.

## Name

`skb_queue_splice` — join two skb lists, this is designed for stacks

## Synopsis

```
void skb_queue_splice (const struct sk_buff_head * list, struct  
sk_buff_head * head);
```

## Arguments

*list* the new list to add

*head* the place to add it in the first list

## Name

`skb_queue_splice_init` — join two skb lists and reinitialise the emptied list

## Synopsis

```
void  skb_queue_splice_init  (struct  sk_buff_head  *  list,  struct  
sk_buff_head  *  head);
```

## Arguments

*list* the new list to add

*head* the place to add it in the first list

## Description

The list at *list* is reinitialised

## Name

`skb_queue_splice_tail` — join two skb lists, each list being a queue

## Synopsis

```
void skb_queue_splice_tail (const struct sk_buff_head * list, struct  
sk_buff_head * head);
```

## Arguments

*list* the new list to add

*head* the place to add it in the first list

## Name

`skb_queue_splice_tail_init` — join two skb lists and reinitialise the emptied list

## Synopsis

```
void skb_queue_splice_tail_init (struct sk_buff_head * list, struct  
sk_buff_head * head);
```

## Arguments

*list* the new list to add

*head* the place to add it in the first list

## Description

Each of the lists is a queue. The list at *list* is reinitialised

## Name

`__skb_queue_after` — queue a buffer at the list head

## Synopsis

```
void __skb_queue_after (struct sk_buff_head * list, struct sk_buff *  
prev, struct sk_buff * newsk);
```

## Arguments

*list*    list to use

*prev*    place after this buffer

*newsk*   buffer to queue

## Description

Queue a buffer into the middle of a list. This function takes no locks and you must therefore hold required locks before calling it.

A buffer cannot be placed on two lists at the same time.

## Name

`__skb_fill_page_desc` — initialise a paged fragment in an `skb`

## Synopsis

```
void __skb_fill_page_desc (struct sk_buff * skb, int i, struct page *  
page, int off, int size);
```

## Arguments

*skb*     buffer containing fragment to be initialised

*i*        paged fragment index to initialise

*page*    the page to use for this fragment

*off*     the offset to the data with *page*

*size*    the length of the data

## Description

Initialises the *i*'th fragment of *skb* to point to *size* bytes at offset *off* within *page*.

Does not take any additional reference on the fragment.



## Name

`skb_fill_page_desc` — initialise a paged fragment in an `skb`

## Synopsis

```
void skb_fill_page_desc (struct sk_buff * skb, int i, struct page *  
page, int off, int size);
```

## Arguments

*skb*     buffer containing fragment to be initialised

*i*        paged fragment index to initialise

*page*    the page to use for this fragment

*off*     the offset to the data with *page*

*size*    the length of the data

## Description

As per `__skb_fill_page_desc` -- initialises the *i*'th fragment of *skb* to point to *size* bytes at offset *off* within *page*. In addition updates *skb* such that *i* is the last fragment.

Does not take any additional reference on the fragment.

## Name

`skb_headroom` — bytes at buffer head

## Synopsis

```
unsigned int skb_headroom (const struct sk_buff * skb);
```

## Arguments

*skb*    buffer to check

## Description

Return the number of bytes of free space at the head of an `sk_buff`.

## Name

`skb_tailroom` — bytes at buffer end

## Synopsis

```
int skb_tailroom (const struct sk_buff * skb);
```

## Arguments

*skb*    buffer to check

## Description

Return the number of bytes of free space at the tail of an `sk_buff`

## Name

`skb_availroom` — bytes at buffer end

## Synopsis

```
int skb_availroom (const struct sk_buff * skb);
```

## Arguments

*skb*    buffer to check

## Description

Return the number of bytes of free space at the tail of an `sk_buff` allocated by `sk_stream_alloc`

## Name

`skb_reserve` — adjust headroom

## Synopsis

```
void skb_reserve (struct sk_buff * skb, int len);
```

## Arguments

*skb*    buffer to alter

*len*    bytes to move

## Description

Increase the headroom of an empty `sk_buff` by reducing the tail room. This is only allowed for an empty buffer.

## Name

`pskb_trim_unique` — remove end from a paged unique (not cloned) buffer

## Synopsis

```
void pskb_trim_unique (struct sk_buff * skb, unsigned int len);
```

## Arguments

*skb*    buffer to alter

*len*    new length

## Description

This is identical to `pskb_trim` except that the caller knows that the `skb` is not cloned so we should never get an error due to out- of-memory.

## Name

`skb_orphan` — orphan a buffer

## Synopsis

```
void skb_orphan (struct sk_buff * skb);
```

## Arguments

*skb*    buffer to orphan

## Description

If a buffer currently has an owner then we call the owner's destructor function and make the *skb* unowned. The buffer continues to exist but is no longer charged to its former owner.

## Name

`skb_orphan_frags` — orphan the frags contained in a buffer

## Synopsis

```
int skb_orphan_frags (struct sk_buff * skb, gfp_t gfp_mask);
```

## Arguments

*skb*            buffer to orphan frags from

*gfp\_mask*    allocation mask for replacement pages

## Description

For each frag in the SKB which needs a destructor (i.e. has an owner) create a copy of that frag and release the original page by calling the destructor.



## Name

`netdev_alloc_skb` — allocate an skbuff for rx on a specific device

## Synopsis

```
struct sk_buff * netdev_alloc_skb (struct net_device * dev, unsigned  
int length);
```

## Arguments

*dev*        network device to receive on

*length*    length to allocate

## Description

Allocate a new `sk_buff` and assign it a usage count of one. The buffer has unspecified headroom built in. Users should allocate the headroom they think they need without accounting for the built in space. The built in space is used for optimisations.

NULL is returned if there is no free memory. Although this function allocates memory it can be called from an interrupt.

## Name

`__skb_alloc_pages` — allocate pages for ps-rx on a skb and preserve pfmemalloc data

## Synopsis

```
struct page * __skb_alloc_pages (gfp_t gfp_mask, struct sk_buff * skb,  
unsigned int order);
```

## Arguments

*gfp\_mask* alloc\_pages\_node mask. Set `__GFP_NOMEMALLOC` if not for network packet RX

*skb* skb to set pfmemalloc on if `__GFP_MEMALLOC` is used

*order* size of the allocation

## Description

Allocate a new page.

NULL is returned if there is no free memory.

## Name

`__skb_alloc_page` — allocate a page for ps-rx for a given skb and preserve pfmemalloc data

## Synopsis

```
struct page * __skb_alloc_page (gfp_t gfp_mask, struct sk_buff * skb);
```

## Arguments

*gfp\_mask* alloc\_pages\_node mask. Set `__GFP_NOMEMALLOC` if not for network packet RX

*skb* skb to set pfmemalloc on if `__GFP_MEMALLOC` is used

## Description

Allocate a new page.

NULL is returned if there is no free memory.

## Name

`skb_propagate_pfmemalloc` — Propagate pfmemalloc if skb is allocated after RX page

## Synopsis

```
void skb_propagate_pfmemalloc (struct page * page, struct sk_buff *  
skb);
```

## Arguments

*page*    The page that was allocated from `skb_alloc_page`

*skb*     The skb that may need pfmemalloc set

## Name

`skb_frag_page` — retrieve the page referred to by a paged fragment

## Synopsis

```
struct page * skb_frag_page (const skb_frag_t * frag);
```

## Arguments

*frag* the paged fragment

## Description

Returns the struct page associated with *frag*.

## Name

`__skb_frag_ref` — take an addition reference on a paged fragment.

## Synopsis

```
void __skb_frag_ref (skb_frag_t * frag);
```

## Arguments

*frag* the paged fragment

## Description

Takes an additional reference on the paged fragment *frag*.

## Name

`skb_frag_ref` — take an addition reference on a paged fragment of an `skb`.

## Synopsis

```
void skb_frag_ref (struct sk_buff * skb, int f);
```

## Arguments

*skb*    the buffer

*f*       the fragment offset.

## Description

Takes an additional reference on the *f*'th paged fragment of *skb*.

## Name

`__skb_frag_unref` — release a reference on a paged fragment.

## Synopsis

```
void __skb_frag_unref (skb_frag_t * frag);
```

## Arguments

*frag* the paged fragment

## Description

Releases a reference on the paged fragment *frag*.



## Name

`skb_frag_unref` — release a reference on a paged fragment of an `skb`.

## Synopsis

```
void skb_frag_unref (struct sk_buff * skb, int f);
```

## Arguments

*skb*    the buffer

*f*       the fragment offset

## Description

Releases a reference on the *f*'th paged fragment of *skb*.

## Name

`skb_frag_address` — gets the address of the data contained in a paged fragment

## Synopsis

```
void * skb_frag_address (const skb_frag_t * frag);
```

## Arguments

*frag* the paged fragment buffer

## Description

Returns the address of the data within *frag*. The page must already be mapped.

## Name

`skb_frag_address_safe` — gets the address of the data contained in a paged fragment

## Synopsis

```
void * skb_frag_address_safe (const skb_frag_t * frag);
```

## Arguments

*frag* the paged fragment buffer

## Description

Returns the address of the data within *frag*. Checks that the page is mapped and returns `NULL` otherwise.

## Name

`__skb_frag_set_page` — sets the page contained in a paged fragment

## Synopsis

```
void __skb_frag_set_page (skb_frag_t * frag, struct page * page);
```

## Arguments

*frag* the paged fragment

*page* the page to set

## Description

Sets the fragment *frag* to contain *page*.

## Name

`skb_frag_set_page` — sets the page contained in a paged fragment of an `skb`

## Synopsis

```
void skb_frag_set_page (struct sk_buff * skb, int f, struct page * page);
```

## Arguments

*skb*     the buffer

*f*       the fragment offset

*page*   the page to set

## Description

Sets the *f*'th fragment of *skb* to contain *page*.

## Name

`skb_frag_dma_map` — maps a paged fragment via the DMA API

## Synopsis

```
dma_addr_t skb_frag_dma_map (struct device * dev, const skb_frag_t *  
frag, size_t offset, size_t size, enum dma_data_direction dir);
```

## Arguments

<i>dev</i>	the device to map the fragment to
<i>frag</i>	the paged fragment to map
<i>offset</i>	the offset within the fragment (starting at the fragment's own offset)
<i>size</i>	the number of bytes to map
<i>dir</i>	the direction of the mapping ( <code>PCI_DMA_*</code> )

## Description

Maps the page associated with *frag* to *device*.

## Name

`skb_clone_writable` — is the header of a clone writable

## Synopsis

```
int skb_clone_writable (const struct sk_buff * skb, unsigned int len);
```

## Arguments

*skb*    buffer to check

*len*    length up to which to write

## Description

Returns true if modifying the header part of the cloned buffer does not requires the data to be copied.

## Name

`skb_cow` — copy header of `skb` when it is required

## Synopsis

```
int skb_cow (struct sk_buff * skb, unsigned int headroom);
```

## Arguments

*skb*            buffer to cow

*headroom*    needed headroom

## Description

If the `skb` passed lacks sufficient headroom or its data part is shared, data is reallocated. If reallocation fails, an error is returned and original `skb` is not changed.

The result is `skb` with writable area `skb->head...skb->tail` and at least *headroom* of space at head.



## Name

`skb_cow_head` — `skb_cow` but only making the head writable

## Synopsis

```
int skb_cow_head (struct sk_buff * skb, unsigned int headroom);
```

## Arguments

*skb*            buffer to cow

*headroom*    needed headroom

## Description

This function is identical to `skb_cow` except that we replace the `skb_cloned` check by `skb_header_cloned`. It should be used when you only need to push on some header and do not need to modify the data.

## Name

`skb_padto` — pad an skbuff up to a minimal size

## Synopsis

```
int skb_padto (struct sk_buff * skb, unsigned int len);
```

## Arguments

*skb*    buffer to pad

*len*    minimal length

## Description

Pads up a buffer to ensure the trailing bytes exist and are blanked. If the buffer already contains sufficient data it is untouched. Otherwise it is extended. Returns zero on success. The `skb` is freed on error.

## Name

`skb_linearize` — convert paged skb to linear one

## Synopsis

```
int skb_linearize (struct sk_buff * skb);
```

## Arguments

*skb*    buffer to linearize

## Description

If there is no free memory -ENOMEM is returned, otherwise zero is returned and the old skb data released.

## Name

`skb_has_shared_frag` — can any frag be overwritten

## Synopsis

```
bool skb_has_shared_frag (const struct sk_buff * skb);
```

## Arguments

*skb*    buffer to test

## Description

Return true if the `skb` has at least one frag that might be modified by an external entity (as in `vmsplice/sendfile`)

## Name

`skb_linearize_cow` — make sure `skb` is linear and writable

## Synopsis

```
int skb_linearize_cow (struct sk_buff * skb);
```

## Arguments

*skb*    buffer to process

## Description

If there is no free memory -ENOMEM is returned, otherwise zero is returned and the old `skb` data released.

## Name

`skb_postpull_rcsum` — update checksum for received skb after pull

## Synopsis

```
void skb_postpull_rcsum (struct sk_buff * skb, const void * start,  
unsigned int len);
```

## Arguments

*skb*      buffer to update

*start*    start of data before pull

*len*      length of data pulled

## Description

After doing a pull on a received packet, you need to call this to update the `CHECKSUM_COMPLETE` checksum, or set `ip_summed` to `CHECKSUM_NONE` so that it can be recomputed from scratch.

## Name

`pskb_trim_rcsum` — trim received skb and update checksum

## Synopsis

```
int pskb_trim_rcsum (struct sk_buff * skb, unsigned int len);
```

## Arguments

*skb*    buffer to trim

*len*    new length

## Description

This is exactly the same as `pskb_trim` except that it ensures the checksum of received packets are still valid after the operation.

## Name

`skb_needs_linearize` — check if we need to linearize a given `skb` depending on the given device features.

## Synopsis

```
bool skb_needs_linearize (struct sk_buff * skb, netdev_features_t  
features);
```

## Arguments

*skb*            socket buffer to check

*features*    net device features

## Returns true if either

1. `skb` has `frag_list` and the device doesn't support `FRAGLIST`, or 2. `skb` is fragmented and the device does not support SG.



## Name

`skb_get_timestamp` — get timestamp from a `skb`

## Synopsis

```
void skb_get_timestamp (const struct sk_buff * skb, struct timeval *  
stamp);
```

## Arguments

*skb*      `skb` to get stamp from

*stamp*   pointer to struct timeval to store stamp in

## Description

Timestamps are stored in the `skb` as offsets to a base timestamp. This function converts the offset back to a struct timeval and stores it in `stamp`.

## Name

`skb_complete_tx_timestamp` — deliver cloned skb with tx timestamps

## Synopsis

```
void skb_complete_tx_timestamp (struct sk_buff * skb, struct
skb_shared_hwtstamps * hwtstamps);
```

## Arguments

*skb* clone of the the original outgoing packet

*hwtstamps* hardware time stamps, may be NULL if not available

## Description

PHY drivers may accept clones of transmitted packets for timestamping via their `phy_driver.txtstamp` method. These drivers must call this function to return the skb back to the stack, with or without a timestamp.

## Name

`skb_tx_timestamp` — Driver hook for transmit timestamping

## Synopsis

```
void skb_tx_timestamp (struct sk_buff * skb);
```

## Arguments

*skb*    A socket buffer.

## Description

Ethernet MAC Drivers should call this function in their `hard_xmit` function immediately before giving the `sk_buff` to the MAC hardware.

Specifically, one should make absolutely sure that this function is called before TX completion of this packet can trigger. Otherwise the packet could potentially already be freed.

## Name

`skb_checksum_complete` — Calculate checksum of an entire packet

## Synopsis

```
__sum16 skb_checksum_complete (struct sk_buff * skb);
```

## Arguments

*skb* packet to process

## Description

This function calculates the checksum over the entire packet plus the value of `skb->csum`. The latter can be used to supply the checksum of a pseudo header as used by TCP/UDP. It returns the checksum.

For protocols that contain complete checksums such as ICMP/TCP/UDP, this function can be used to verify that checksum on received packets. In that case the function should return zero if the checksum is correct. In particular, this function will return zero if `skb->ip_summed` is `CHECKSUM_UNNECESSARY` which indicates that the hardware has already verified the correctness of the checksum.

## Name

`skb_checksum_none_assert` — make sure `skb` `ip_summed` is `CHECKSUM_NONE`

## Synopsis

```
void skb_checksum_none_assert (const struct sk_buff * skb);
```

## Arguments

*skb*    `skb` to check

## Description

fresh skbs have their `ip_summed` set to `CHECKSUM_NONE`. Instead of forcing `ip_summed` to `CHECKSUM_NONE`, we can use this helper, to document places where we make this assertion.

## Name

`skb_head_is_locked` — Determine if the `skb->head` is locked down

## Synopsis

```
bool skb_head_is_locked (const struct sk_buff * skb);
```

## Arguments

*skb*    `skb` to check

## Description

The head on skbs build around a head frag can be removed if they are not cloned. This function returns true if the `skb` head is locked down due to either being allocated via `kmalloc`, or by being a clone with multiple references to the head.

## Name

`skb_gso_network_seglen` — Return length of individual segments of a gso packet

## Synopsis

```
unsigned int skb_gso_network_seglen (const struct sk_buff * skb);
```

## Arguments

*skb*    GSO skb

## Description

`skb_gso_network_seglen` is used to determine the real size of the individual segments, including Layer3 (IP, IPv6) and L4 headers (TCP/UDP).

The MAC/L2 header is not accounted for.

## Name

struct sock\_common — minimal network layer representation of sockets

## Synopsis

```
struct sock_common {  
    union {unnamed_union};  
    int skc_tx_queue_mapping;  
    atomic_t skc_refcnt;  
};
```

## Members

{unnamed_union}	anonymous
skc_tx_queue_mapping	tx queue number for this connection
skc_refcnt	reference count

## Description

This is the minimal network layer representation of sockets, the header for struct sock and struct inet\_timewait\_sock.



## Name

struct sock — network layer representation of sockets

## Synopsis

```
struct sock {
    struct sock_common __sk_common;
#define sk_node      __sk_common.skc_node
#define sk_nulls_node __sk_common.skc_nulls_node
#define sk_refcnt    __sk_common.skc_refcnt
#define sk_tx_queue_mapping __sk_common.skc_tx_queue_mapping
#define sk_dontcopy_begin __sk_common.skc_dontcopy_begin
#define sk_dontcopy_end __sk_common.skc_dontcopy_end
#define sk_hash      __sk_common.skc_hash
#define sk_portpair  __sk_common.skc_portpair
#define sk_num       __sk_common.skc_num
#define sk_dport     __sk_common.skc_dport
#define sk_addrpair  __sk_common.skc_addrpair
#define sk_daddr     __sk_common.skc_daddr
#define sk_rcv_saddr __sk_common.skc_rcv_saddr
#define sk_family    __sk_common.skc_family
#define sk_state     __sk_common.skc_state
#define sk_reuse     __sk_common.skc_reuse
#define sk_reuseport __sk_common.skc_reuseport
#define sk_bound_dev_if __sk_common.skc_bound_dev_if
#define sk_bind_node __sk_common.skc_bind_node
#define sk_prot      __sk_common.skc_prot
#define sk_net       __sk_common.skc_net
#define sk_v6_daddr  __sk_common.skc_v6_daddr
#define sk_v6_rcv_saddr __sk_common.skc_v6_rcv_saddr
    socket_lock_t sk_lock;
    struct sk_buff_head sk_receive_queue;
    struct sk_backlog;
#define sk_rmem_alloc sk_backlog.rmem_alloc
    int sk_forward_alloc;
#ifdef CONFIG_RPS
    __u32 sk_rxhash;
#endif
#ifdef CONFIG_NET_RX_BUSY_POLL
    unsigned int sk_napi_id;
    unsigned int sk_ll_usec;
#endif
    atomic_t sk_drops;
    int sk_rcvbuf;
    struct sk_filter __rcu * sk_filter;
    struct socket_wq __rcu * sk_wq;
#ifdef CONFIG_NET_DMA
    struct sk_buff_head sk_async_wait_queue;
#endif
#ifdef CONFIG_XFRM
    struct xfrm_policy * sk_policy[2];
#endif
}
```

```
unsigned long sk_flags;
struct dst_entry * sk_rx_dst;
struct dst_entry __rcu * sk_dst_cache;
spinlock_t sk_dst_lock;
atomic_t sk_wmem_alloc;
atomic_t sk_omem_alloc;
int sk_sndbuf;
struct sk_buff_head sk_write_queue;
unsigned int sk_shutdown:2;
unsigned int sk_no_check_tx:1;
unsigned int sk_no_check_rx:1;
unsigned int sk_userlocks:4;
unsigned int sk_protocol:8;
#define SK_PROTOCOL_MAX U8_MAX
int sk_wmem_queued;
gfp_t sk_allocation;
u32 sk_pacing_rate;
u32 sk_max_pacing_rate;
netdev_features_t sk_route_caps;
netdev_features_t sk_route_nocaps;
int sk_gso_type;
unsigned int sk_gso_max_size;
u16 sk_gso_max_segs;
int sk_rcvlowat;
unsigned long sk_lingertime;
struct sk_buff_head sk_error_queue;
struct proto * sk_prot_creator;
rwlock_t sk_callback_lock;
int sk_err;
int sk_err_soft;
unsigned short sk_ack_backlog;
unsigned short sk_max_ack_backlog;
__u32 sk_priority;
#if IS_ENABLED(CONFIG_CGROUP_NET_PRIO)
__u32 sk_cgrp_prioidx;
#endif
struct pid * sk_peer_pid;
const struct cred * sk_peer_cred;
long sk_rcvtimeo;
long sk_sndtimeo;
void * sk_protinfo;
struct timer_list sk_timer;
ktime_t sk_stamp;
struct socket * sk_socket;
void * sk_user_data;
struct page_frag sk_frag;
struct sk_buff * sk_send_head;
__s32 sk_peek_off;
int sk_write_pending;
#ifdef CONFIG_SECURITY
void * sk_security;
#endif
__u32 sk_mark;
u32 sk_classid;
```

```
struct cg_proto * sk_cgrp;
void (* sk_state_change) (struct sock *sk);
void (* sk_data_ready) (struct sock *sk);
void (* sk_write_space) (struct sock *sk);
void (* sk_error_report) (struct sock *sk);
int (* sk_backlog_rcv) (struct sock *sk, struct sk_buff *skb);
void (* sk_destruct) (struct sock *sk);
};
```

## Members

__sk_common	shared layout with inet_timewait_sock
sk_lock	synchronizer
sk_receive_queue	incoming packets
sk_backlog	always used with the per-socket spinlock held
sk_forward_alloc	space allocated forward
sk_rxhash	flow hash received from netif layer
sk_napi_id	id of the last napi context to receive data for sk
sk_ll_usec	usecs to busypoll when there is no data
sk_drops	raw/udp drops counter
sk_rcvbuf	size of receive buffer in bytes
sk_filter	socket filtering instructions
sk_wq	sock wait queue and async head
sk_async_wait_queue	DMA copied packets
sk_policy[2]	flow policy
sk_flags	SO_LINGER (l_onoff), SO_BROADCAST, SO_KEEPAIVE, SO_OOINLINE settings, SO_TIMESTAMPING settings
sk_rx_dst	receive input route used by early demux
sk_dst_cache	destination cache
sk_dst_lock	destination cache lock
sk_wmem_alloc	transmit queue bytes committed
sk_omem_alloc	"o" is "option" or "other"
sk_sndbuf	size of send buffer in bytes
sk_write_queue	Packet sending queue
sk_shutdown	mask of SEND_SHUTDOWN and/or RCV_SHUTDOWN

<code>sk_no_check_tx</code>	<code>SO_NO_CHECK</code> setting, set checksum in TX packets
<code>sk_no_check_rx</code>	allow zero checksum in RX packets
<code>sk_userlocks</code>	<code>SO_SNDBUF</code> and <code>SO_RCVBUF</code> settings
<code>sk_protocol</code>	which protocol this socket belongs in this network family
<code>sk_wmem_queued</code>	persistent queue size
<code>sk_allocation</code>	allocation mode
<code>sk_pacing_rate</code>	Pacing rate (if supported by transport/packet scheduler)
<code>sk_max_pacing_rate</code>	Maximum pacing rate ( <code>SO_MAX_PACING_RATE</code> )
<code>sk_route_caps</code>	route capabilities (e.g. <code>NETIF_F_TSO</code> )
<code>sk_route_nocaps</code>	forbidden route capabilities (e.g. <code>NETIF_F_GSO_MASK</code> )
<code>sk_gso_type</code>	GSO type (e.g. <code>SKB_GSO_TCPV4</code> )
<code>sk_gso_max_size</code>	Maximum GSO segment size to build
<code>sk_gso_max_segs</code>	Maximum number of GSO segments
<code>sk_rcvlowat</code>	<code>SO_RCVLOWAT</code> setting
<code>sk_lingertime</code>	<code>SO_LINGER l_linger</code> setting
<code>sk_error_queue</code>	rarely used
<code>sk_prot_creator</code>	<code>sk_prot</code> of original sock creator (see <code>ipv6_setsockopt</code> , <code>IPV6_ADDRFORM</code> for instance)
<code>sk_callback_lock</code>	used with the callbacks in the end of this struct
<code>sk_err</code>	last error
<code>sk_err_soft</code>	errors that don't cause failure but are the cause of a persistent failure not just 'timed out'
<code>sk_ack_backlog</code>	current listen backlog
<code>sk_max_ack_backlog</code>	listen backlog set in <code>listen</code>
<code>sk_priority</code>	<code>SO_PRIORITY</code> setting
<code>sk_cgrp_prioidx</code>	socket group's priority map index
<code>sk_peer_pid</code>	struct pid for this socket's peer
<code>sk_peer_cred</code>	<code>SO_PEERCRED</code> setting
<code>sk_rcvtimeo</code>	<code>SO_RCVTIMEO</code> setting
<code>sk_sndtimeo</code>	<code>SO_SNDTIMEO</code> setting
<code>sk_protinfo</code>	private area, net family specific, when not using slab

sk_timer	sock cleanup timer
sk_stamp	time stamp of last packet received
sk_socket	Identd and reporting IO signals
sk_user_data	RPC layer private data
sk_frag	cached page frag
sk_send_head	front of stuff to transmit
sk_peek_off	current peek_offset value
sk_write_pending	a write to stream socket waits to start
sk_security	used by security modules
sk_mark	generic packet mark
sk_classid	this socket's cgroup classid
sk_cgrp	this socket's cgroup-specific proto data
sk_state_change	callback to indicate change in the state of the sock
sk_data_ready	callback to indicate there is data to be processed
sk_write_space	callback to indicate there is bf sending space available
sk_error_report	callback to indicate errors (e.g. MSG_ERRQUEUE)
sk_backlog_rcv	callback to process the backlog
sk_destruct	called at sock freeing time, i.e. when all refcnt == 0

## Name

`unlock_sock_fast` — complement of `lock_sock_fast`

## Synopsis

```
void unlock_sock_fast (struct sock * sk, bool slow);
```

## Arguments

*sk*      socket

*slow*    slow mode

## Description

fast unlock socket for user context. If slow mode is on, we call regular `release_sock`

## Name

`sk_wmem_alloc_get` — returns write allocations

## Synopsis

```
int sk_wmem_alloc_get (const struct sock * sk);
```

## Arguments

*sk* socket

## Description

Returns `sk_wmem_alloc` minus initial offset of one

## Name

`sk_rmem_alloc_get` — returns read allocations

## Synopsis

```
int sk_rmem_alloc_get (const struct sock * sk);
```

## Arguments

*sk* socket

## Description

Returns `sk_rmem_alloc`



## Name

`sk_has_allocations` — check if allocations are outstanding

## Synopsis

```
bool sk_has_allocations (const struct sock * sk);
```

## Arguments

*sk* socket

## Description

Returns true if socket has write or read allocations

## Name

wq\_has\_sleeper — check if there are any waiting processes

## Synopsis

```
bool wq_has_sleeper (struct socket_wq * wq);
```

## Arguments

wq    struct socket\_wq

## Description

Returns true if socket\_wq has waiting processes

The purpose of the wq\_has\_sleeper and sock\_poll\_wait is to wrap the memory barrier call. They were added due to the race found within the tcp code.

## Consider following tcp code paths

CPU1 CPU2

```
sys_select receive packet ... .. __add_wait_queue update tp->rcv_nxt ... .. tp->rcv_nxt check  
sock_def_readable ... { schedule rcu_read_lock; wq = rcu_dereference(sk->sk_wq); if (wq &&  
waitqueue_active(wq->wait)) wake_up_interruptible(wq->wait) ... }
```

The race for tcp fires when the \_\_add\_wait\_queue changes done by CPU1 stay in its cache, and so does the tp->rcv\_nxt update on CPU2 side. The CPU1 could then endup calling schedule and sleep forever if there are no more data on the socket.

## Name

`sock_poll_wait` — place memory barrier behind the `poll_wait` call.

## Synopsis

```
void sock_poll_wait (struct file * filp, wait_queue_head_t *  
wait_address, poll_table * p);
```

## Arguments

<i>filp</i>	file
<i>wait_address</i>	socket wait queue
<i>p</i>	poll_table

## Description

See the comments in the `wq_has_sleeper` function.

## Name

`sk_page_frag` — return an appropriate `page_frag`

## Synopsis

```
struct page_frag * sk_page_frag (struct sock * sk);
```

## Arguments

*sk* socket

## Description

If socket allocation mode allows current thread to sleep, it means its safe to use the per task `page_frag` instead of the per socket one.

## Name

`sk_eat_skb` — Release a skb if it is no longer needed

## Synopsis

```
void sk_eat_skb (struct sock * sk, struct sk_buff * skb, bool  
copied_early);
```

## Arguments

*sk*                      socket to eat this skb from

*skb*                     socket buffer to eat

*copied\_early*          flag indicating whether DMA operations copied this data early

## Description

This routine must be called with interrupts disabled or with the socket locked so that the `sk_buff` queue operation is ok.

## Name

`sockfd_lookup` — Go from a file number to its socket slot

## Synopsis

```
struct socket * sockfd_lookup (int fd, int * err);
```

## Arguments

*fd*    file handle

*err*   pointer to an error code return

## Description

The file handle passed in is locked and the socket it is bound too is returned. If an error occurs the `err` pointer is overwritten with a negative `errno` code and `NULL` is returned. The function checks for both invalid handles and passing a handle which is not a socket.

On a success the socket object pointer is returned.

## Name

`sock_release` — close a socket

## Synopsis

```
void sock_release (struct socket * sock);
```

## Arguments

*sock*    socket to close

## Description

The socket is released from the protocol stack if it has a release callback, and the inode is then released if the socket is bound to an inode not a file.

## Name

`kernel_recvmsg` — Receive a message from a socket (kernel space)

## Synopsis

```
int kernel_recvmsg (struct socket * sock, struct msghdr * msg, struct
kvec * vec, size_t num, size_t size, int flags);
```

## Arguments

<i>sock</i>	The socket to receive the message from
<i>msg</i>	Received message
<i>vec</i>	Input s/g array for message data
<i>num</i>	Size of input s/g array
<i>size</i>	Number of bytes to read
<i>flags</i>	Message flags (MSG_DONTWAIT, etc...)

## Description

On return the `msg` structure contains the scatter/gather array passed in the `vec` argument. The array is modified so that it consists of the unfilled portion of the original array.

The returned value is the total number of bytes received, or an error.



## Name

`sock_register` — add a socket protocol handler

## Synopsis

```
int sock_register (const struct net_proto_family * ops);
```

## Arguments

*ops*    description of protocol

## Description

This function is called by a protocol handler that wants to advertise its address family, and have it linked into the socket interface. The value `ops->family` corresponds to the socket system call protocol family.

## Name

`sock_unregister` — remove a protocol handler

## Synopsis

```
void sock_unregister (int family);
```

## Arguments

*family* protocol family to remove

## Description

This function is called by a protocol handler that wants to remove its address family, and have it unlinked from the new socket creation.

If protocol handler is a module, then it can use module reference counts to protect against new references. If protocol handler is not a module then it needs to provide its own protection in the ops->create routine.

## Name

`__alloc_skb` — allocate a network buffer

## Synopsis

```
struct sk_buff * __alloc_skb (unsigned int size, gfp_t gfp_mask, int
flags, int node);
```

## Arguments

*size*            size to allocate

*gfp\_mask*      allocation mask

*flags*            If SKB\_ALLOC\_FCLONE is set, allocate from fclone cache instead of head cache and allocate a cloned (child) skb. If SKB\_ALLOC\_RX is set, \_\_GFP\_MEMALLOC will be used for allocations in case the data is required for writeback

*node*            numa node to allocate memory on

## Description

Allocate a new sk\_buff. The returned buffer has no headroom and a tail room of at least size bytes. The object has a reference count of one. The return is the buffer. On a failure the return is NULL.

Buffers may only be allocated from interrupts using a *gfp\_mask* of GFP\_ATOMIC.

## Name

`build_skb` — build a network buffer

## Synopsis

```
struct sk_buff * build_skb (void * data, unsigned int frag_size);
```

## Arguments

*data*            data buffer provided by caller

*frag\_size*    size of fragment, or 0 if head was kmalloced

## Description

Allocate a new `sk_buff`. Caller provides space holding head and `skb_shared_info`. *data* must have been allocated by `kmalloc` only if *frag\_size* is 0, otherwise data should come from the page allocator. The return is the new `skb` buffer. On a failure the return is `NULL`, and *data* is not freed.

## Notes

Before IO, driver allocates only data buffer where NIC put incoming frame. Driver should add room at head (`NET_SKB_PAD`) and MUST add room at tail (`SKB_DATA_ALIGN(skb_shared_info)`). After IO, driver calls `build_skb`, to allocate `sk_buff` and populate it before giving packet to stack. RX rings only contain data buffers, not full `skbs`.

## Name

netdev\_alloc\_frag — allocate a page fragment

## Synopsis

```
void * netdev_alloc_frag (unsigned int fragsz);
```

## Arguments

*fragsz*    fragment size

## Description

Allocates a frag from a page for receive buffer. Uses GFP\_ATOMIC allocations.

## Name

`__netdev_alloc_skb` — allocate an skbuff for rx on a specific device

## Synopsis

```
struct sk_buff * __netdev_alloc_skb (struct net_device * dev, unsigned
int length, gfp_t gfp_mask);
```

## Arguments

<i>dev</i>	network device to receive on
<i>length</i>	length to allocate
<i>gfp_mask</i>	get_free_pages mask, passed to alloc_skb

## Description

Allocate a new `sk_buff` and assign it a usage count of one. The buffer has unspecified headroom built in. Users should allocate the headroom they think they need without accounting for the built in space. The built in space is used for optimisations.

NULL is returned if there is no free memory.

## Name

`__kfree_skb` — private function

## Synopsis

```
void __kfree_skb (struct sk_buff * skb);
```

## Arguments

*skb*    buffer

## Description

Free an `sk_buff`. Release anything attached to the buffer. Clean the state. This is an internal helper function. Users should always call `kfree_skb`

## Name

kfree\_skb — free an sk\_buff

## Synopsis

```
void kfree_skb (struct sk_buff * skb);
```

## Arguments

*skb*    buffer to free

## Description

Drop a reference to the buffer and free it if the usage count has hit zero.



## Name

`skb_tx_error` — report an `sk_buff` xmit error

## Synopsis

```
void skb_tx_error (struct sk_buff * skb);
```

## Arguments

*skb*    buffer that triggered an error

## Description

Report xmit error if a device callback is tracking this `skb`. `skb` must be freed afterwards.

## Name

consume\_skb — free an skbuff

## Synopsis

```
void consume_skb (struct sk_buff * skb);
```

## Arguments

*skb*    buffer to free

## Description

Drop a ref to the buffer and free it if the usage count has hit zero Functions identically to kfree\_skb, but kfree\_skb assumes that the frame is being dropped after a failure and notes that

## Name

`skb_morph` — morph one skb into another

## Synopsis

```
struct sk_buff * skb_morph (struct sk_buff * dst, struct sk_buff * src);
```

## Arguments

*dst* the skb to receive the contents

*src* the skb to supply the contents

## Description

This is identical to `skb_clone` except that the target skb is supplied by the user.

The target skb is returned upon exit.

## Name

`skb_copy_ubufs` — copy userspace skb frags buffers to kernel

## Synopsis

```
int skb_copy_ubufs (struct sk_buff * skb, gfp_t gfp_mask);
```

## Arguments

*skb*            the skb to modify

*gfp\_mask*    allocation priority

## Description

This must be called on `SKBTX_DEV_ZEROCOPY` skb. It will copy all frags into kernel and drop the reference to userspace pages.

If this function is called from an interrupt `gfp_mask` must be `GFP_ATOMIC`.

Returns 0 on success or a negative error code on failure to allocate kernel memory to copy to.

## Name

`skb_clone` — duplicate an `sk_buff`

## Synopsis

```
struct sk_buff * skb_clone (struct sk_buff * skb, gfp_t gfp_mask);
```

## Arguments

*skb*            buffer to clone

*gfp\_mask*    allocation priority

## Description

Duplicate an `sk_buff`. The new one is not owned by a socket. Both copies share the same packet data but not structure. The new buffer has a reference count of 1. If the allocation fails the function returns `NULL` otherwise the new buffer is returned.

If this function is called from an interrupt `gfp_mask` must be `GFP_ATOMIC`.

## Name

`skb_copy` — create private copy of an `sk_buff`

## Synopsis

```
struct sk_buff * skb_copy (const struct sk_buff * skb, gfp_t gfp_mask);
```

## Arguments

*skb*            buffer to copy

*gfp\_mask*    allocation priority

## Description

Make a copy of both an `sk_buff` and its data. This is used when the caller wishes to modify the data and needs a private copy of the data to alter. Returns `NULL` on failure or the pointer to the buffer on success. The returned buffer has a reference count of 1.

As by-product this function converts non-linear `sk_buff` to linear one, so that `sk_buff` becomes completely private and caller is allowed to modify all the data of returned buffer. This means that this function is not recommended for use in circumstances when only header is going to be modified. Use `pskb_copy` instead.

## Name

`__pskb_copy_fclone` — create copy of an `sk_buff` with private head.

## Synopsis

```
struct sk_buff * __pskb_copy_fclone (struct sk_buff * skb, int headroom,  
gfp_t gfp_mask, bool fclone);
```

## Arguments

<i>skb</i>	buffer to copy
<i>headroom</i>	headroom of new skb
<i>gfp_mask</i>	allocation priority
<i>fclone</i>	if true allocate the copy of the skb from the fclone cache instead of the head cache; it is recommended to set this to true for the cases where the copy will likely be cloned

## Description

Make a copy of both an `sk_buff` and part of its data, located in header. Fragmented data remain shared. This is used when the caller wishes to modify only header of `sk_buff` and needs private copy of the header to alter. Returns `NULL` on failure or the pointer to the buffer on success. The returned buffer has a reference count of 1.

## Name

`pskb_expand_head` — reallocate header of `sk_buff`

## Synopsis

```
int pskb_expand_head (struct sk_buff * skb, int nhead, int ntail, gfp_t  
gfp_mask);
```

## Arguments

<i>skb</i>	buffer to reallocate
<i>nhead</i>	room to add at head
<i>ntail</i>	room to add at tail
<i>gfp_mask</i>	allocation priority

## Description

Expands (or creates identical copy, if *nhead* and *ntail* are zero) header of *skb*. `sk_buff` itself is not changed. `sk_buff` MUST have reference count of 1. Returns zero in the case of success or error, if expansion failed. In the last case, `sk_buff` is not changed.

All the pointers pointing into `skb` header may change and must be reloaded after call to this function.



## Name

`skb_copy_expand` — copy and expand `sk_buff`

## Synopsis

```
struct sk_buff * skb_copy_expand (const struct sk_buff * skb, int
newheadroom, int newtailroom, gfp_t gfp_mask);
```

## Arguments

<i>skb</i>	buffer to copy
<i>newheadroom</i>	new free bytes at head
<i>newtailroom</i>	new free bytes at tail
<i>gfp_mask</i>	allocation priority

## Description

Make a copy of both an `sk_buff` and its data and while doing so allocate additional space.

This is used when the caller wishes to modify the data and needs a private copy of the data to alter as well as more space for new fields. Returns `NULL` on failure or the pointer to the buffer on success. The returned buffer has a reference count of 1.

You must pass `GFP_ATOMIC` as the allocation priority if this function is called from an interrupt.

## Name

`skb_pad` — zero pad the tail of an `skb`

## Synopsis

```
int skb_pad (struct sk_buff * skb, int pad);
```

## Arguments

*skb*    buffer to pad

*pad*    space to pad

## Description

Ensure that a buffer is followed by a padding area that is zero filled. Used by network drivers which may DMA or transfer data beyond the buffer end onto the wire.

May return error in out of memory cases. The `skb` is freed on error.

## Name

`pskb_put` — add data to the tail of a potentially fragmented buffer

## Synopsis

```
unsigned char * pskb_put (struct sk_buff * skb, struct sk_buff * tail,  
int len);
```

## Arguments

*skb*     start of the buffer to use

*tail*   tail fragment of the buffer to use

*len*     amount of data to add

## Description

This function extends the used data area of the potentially fragmented buffer. *tail* must be the last fragment of *skb* -- or *skb* itself. If this would exceed the total buffer size the kernel will panic. A pointer to the first byte of the extra data is returned.

## Name

`skb_put` — add data to a buffer

## Synopsis

```
unsigned char * skb_put (struct sk_buff * skb, unsigned int len);
```

## Arguments

*skb*    buffer to use

*len*    amount of data to add

## Description

This function extends the used data area of the buffer. If this would exceed the total buffer size the kernel will panic. A pointer to the first byte of the extra data is returned.

## Name

`skb_push` — add data to the start of a buffer

## Synopsis

```
unsigned char * skb_push (struct sk_buff * skb, unsigned int len);
```

## Arguments

*skb*    buffer to use

*len*    amount of data to add

## Description

This function extends the used data area of the buffer at the buffer start. If this would exceed the total buffer headroom the kernel will panic. A pointer to the first byte of the extra data is returned.

## Name

`skb_pull` — remove data from the start of a buffer

## Synopsis

```
unsigned char * skb_pull (struct sk_buff * skb, unsigned int len);
```

## Arguments

*skb*    buffer to use

*len*    amount of data to remove

## Description

This function removes data from the start of a buffer, returning the memory to the headroom. A pointer to the next data in the buffer is returned. Once the data has been pulled future pushes will overwrite the old data.

## Name

`skb_trim` — remove end from a buffer

## Synopsis

```
void skb_trim (struct sk_buff * skb, unsigned int len);
```

## Arguments

*skb*    buffer to alter

*len*    new length

## Description

Cut the length of a buffer down by removing data from the tail. If the buffer is already under the length specified it is not modified. The `skb` must be linear.

## Name

`__pskb_pull_tail` — advance tail of skb header

## Synopsis

```
unsigned char * __pskb_pull_tail (struct sk_buff * skb, int delta);
```

## Arguments

*skb*      buffer to reallocate

*delta*    number of bytes to advance tail

## Description

The function makes a sense only on a fragmented `sk_buff`, it expands header moving its tail forward and copying necessary data from fragmented part.

`sk_buff` MUST have reference count of 1.

Returns `NULL` (and `sk_buff` does not change) if pull failed or value of new tail of `skb` in the case of success.

All the pointers pointing into `skb` header may change and must be reloaded after call to this function.



## Name

`skb_copy_bits` — copy bits from skb to kernel buffer

## Synopsis

```
int skb_copy_bits (const struct sk_buff * skb, int offset, void * to,  
int len);
```

## Arguments

<i>skb</i>	source skb
<i>offset</i>	offset in source
<i>to</i>	destination buffer
<i>len</i>	number of bytes to copy

## Description

Copy the specified number of bytes from the source skb to the destination buffer.

CAUTION ! : If its prototype is ever changed, check arch/{\*}/net/{\*}.S files, since it is called from BPF assembly code.

## Name

`skb_store_bits` — store bits from kernel buffer to skb

## Synopsis

```
int skb_store_bits (struct sk_buff * skb, int offset, const void * from,  
int len);
```

## Arguments

<i>skb</i>	destination buffer
<i>offset</i>	offset in destination
<i>from</i>	source buffer
<i>len</i>	number of bytes to copy

## Description

Copy the specified number of bytes from the source buffer to the destination skb. This function handles all the messy bits of traversing fragment lists and such.

## Name

`skb_zerocopy` — Zero copy skb to skb

## Synopsis

```
int skb_zerocopy (struct sk_buff * to, struct sk_buff * from, int len,  
int hlen);
```

## Arguments

*to* destination buffer

*from* source buffer

*len* number of bytes to copy from source buffer

*hlen* size of linear headroom in destination buffer

## Description

Copies up to `len` bytes from `from` to `to` by creating references to the frags in the source buffer.

The `hlen` as calculated by `skb_zerocopy_headlen` specifies the headroom in the `to` buffer.

## 0

everything is OK -ENOMEM: couldn't orphan frags of *from* due to lack of memory -EFAULT:  
`skb_copy_bits` found some problem with skb geometry

## Name

`skb_dequeue` — remove from the head of the queue

## Synopsis

```
struct sk_buff * skb_dequeue (struct sk_buff_head * list);
```

## Arguments

*list* list to dequeue from

## Description

Remove the head of the list. The list lock is taken so the function may be used safely with other locking list functions. The head item is returned or NULL if the list is empty.

## Name

`skb_dequeue_tail` — remove from the tail of the queue

## Synopsis

```
struct sk_buff * skb_dequeue_tail (struct sk_buff_head * list);
```

## Arguments

*list* list to dequeue from

## Description

Remove the tail of the list. The list lock is taken so the function may be used safely with other locking list functions. The tail item is returned or NULL if the list is empty.

## Name

`skb_queue_purge` — empty a list

## Synopsis

```
void skb_queue_purge (struct sk_buff_head * list);
```

## Arguments

*list* list to empty

## Description

Delete all buffers on an `sk_buff` list. Each buffer is removed from the list and one reference dropped. This function takes the list lock and is atomic with respect to other list locking functions.

## Name

`skb_queue_head` — queue a buffer at the list head

## Synopsis

```
void skb_queue_head (struct sk_buff_head * list, struct sk_buff * newsk);
```

## Arguments

*list*     list to use

*newsk*    buffer to queue

## Description

Queue a buffer at the start of the list. This function takes the list lock and can be used safely with other locking `sk_buff` functions safely.

A buffer cannot be placed on two lists at the same time.

## Name

`skb_queue_tail` — queue a buffer at the list tail

## Synopsis

```
void skb_queue_tail (struct sk_buff_head * list, struct sk_buff * newsk);
```

## Arguments

*list*     list to use

*newsk*    buffer to queue

## Description

Queue a buffer at the tail of the list. This function takes the list lock and can be used safely with other locking `sk_buff` functions safely.

A buffer cannot be placed on two lists at the same time.



## Name

`skb_unlink` — remove a buffer from a list

## Synopsis

```
void skb_unlink (struct sk_buff * skb, struct sk_buff_head * list);
```

## Arguments

*skb*     buffer to remove

*list*    list to use

## Description

Remove a packet from a list. The list locks are taken and this function is atomic with respect to other list locked calls

You must know what list the SKB is on.

## Name

`skb_append` — append a buffer

## Synopsis

```
void skb_append (struct sk_buff * old, struct sk_buff * newsk, struct  
sk_buff_head * list);
```

## Arguments

*old*      buffer to insert after

*newsk*    buffer to insert

*list*     list to use

## Description

Place a packet after a given packet in a list. The list locks are taken and this function is atomic with respect to other list locked calls. A buffer cannot be placed on two lists at the same time.

## Name

`skb_insert` — insert a buffer

## Synopsis

```
void skb_insert (struct sk_buff * old, struct sk_buff * newsk, struct  
sk_buff_head * list);
```

## Arguments

*old*      buffer to insert before

*newsk*    buffer to insert

*list*     list to use

## Description

Place a packet before a given packet in a list. The list locks are taken and this function is atomic with respect to other list locked calls.

A buffer cannot be placed on two lists at the same time.

## Name

`skb_split` — Split fragmented `skb` to two parts at length `len`.

## Synopsis

```
void skb_split (struct sk_buff * skb, struct sk_buff * skb1, const u32  
len);
```

## Arguments

*skb*     the buffer to split

*skb1*   the buffer to receive the second part

*len*     new length for `skb`

## Name

`skb_prepare_seq_read` — Prepare a sequential read of skb data

## Synopsis

```
void skb_prepare_seq_read (struct sk_buff * skb, unsigned int from,  
unsigned int to, struct skb_seq_state * st);
```

## Arguments

*skb*     the buffer to read

*from*   lower offset of data to be read

*to*     upper offset of data to be read

*st*     state variable

## Description

Initializes the specified state variable. Must be called before invoking `skb_seq_read` for the first time.

## Name

`skb_seq_read` — Sequentially read skb data

## Synopsis

```
unsigned int skb_seq_read (unsigned int consumed, const u8 ** data,  
struct skb_seq_state * st);
```

## Arguments

*consumed*    number of bytes consumed by the caller so far

*data*        destination pointer for data to be returned

*st*          state variable

## Description

Reads a block of skb data at *consumed* relative to the lower offset specified to `skb_prepare_seq_read`. Assigns the head of the data block to *data* and returns the length of the block or 0 if the end of the skb data or the upper offset has been reached.

The caller is not required to consume all of the data returned, i.e. *consumed* is typically set to the number of bytes already consumed and the next call to `skb_seq_read` will return the remaining part of the block.

## Note 1

The size of each block of data returned can be arbitrary, this limitation is the cost for zerocopy sequential reads of potentially non linear data.

## Note 2

Fragment lists within fragments are not implemented at the moment, `state->root_skb` could be replaced with a stack for this purpose.

## Name

`skb_abort_seq_read` — Abort a sequential read of skb data

## Synopsis

```
void skb_abort_seq_read (struct skb_seq_state * st);
```

## Arguments

*st* state variable

## Description

Must be called if `skb_seq_read` was not called until it returned 0.

## Name

`skb_find_text` — Find a text pattern in skb data

## Synopsis

```
unsigned int skb_find_text (struct sk_buff * skb, unsigned int from,  
unsigned int to, struct ts_config * config, struct ts_state * state);
```

## Arguments

<i>skb</i>	the buffer to look in
<i>from</i>	search offset
<i>to</i>	search limit
<i>config</i>	textsearch configuration
<i>state</i>	uninitialized textsearch state variable

## Description

Finds a pattern in the skb data according to the specified textsearch configuration. Use `textsearch_next` to retrieve subsequent occurrences of the pattern. Returns the offset to the first occurrence or `UINT_MAX` if no match was found.



## Name

`skb_append_datato_frags` — append the user data to a skb

## Synopsis

```
int skb_append_datato_frags (struct sock * sk, struct sk_buff * skb,
int (*getfrag) (void *from, char *to, int offset, int len, int odd,
struct sk_buff *skb), void * from, int length);
```

## Arguments

<i>sk</i>	sock structure
<i>skb</i>	skb structure to be appened with user data.
<i>getfrag</i>	call back function to be used for getting the user data
<i>from</i>	pointer to user message iov
<i>length</i>	length of the iov message

## Description

This procedure append the user data in the fragment part of the skb if any page alloc fails user this procedure returns -ENOMEM

## Name

`skb_pull_rcsum` — pull skb and update receive checksum

## Synopsis

```
unsigned char * skb_pull_rcsum (struct sk_buff * skb, unsigned int len);
```

## Arguments

*skb*    buffer to update

*len*    length of data pulled

## Description

This function performs an `skb_pull` on the packet and updates the `CHECKSUM_COMPLETE` checksum. It should be used on receive path processing instead of `skb_pull` unless you know that the checksum difference is zero (e.g., a valid IP header) or you are setting `ip_summed` to `CHECKSUM_NONE`.

## Name

`skb_segment` — Perform protocol segmentation on `skb`.

## Synopsis

```
struct sk_buff * skb_segment (struct sk_buff * head_skb,  
netdev_features_t features);
```

## Arguments

*head\_skb* buffer to segment

*features* features for the output path (see `dev->features`)

## Description

This function performs segmentation on the given `skb`. It returns a pointer to the first in a list of new skbs for the segments. In case of error it returns `ERR_PTR(err)`.

## Name

`skb_cow_data` — Check that a socket buffer's data buffers are writable

## Synopsis

```
int skb_cow_data (struct sk_buff * skb, int tailbits, struct sk_buff  
** trailer);
```

## Arguments

*skb*            The socket buffer to check.

*tailbits*    Amount of trailing space to be added

*trailer*      Returned pointer to the *skb* where the *tailbits* space begins

## Description

Make sure that the data buffers attached to a socket buffer are writable. If they are not, private copies are made of the data buffers and the socket buffer is set to use these instead.

If *tailbits* is given, make sure that there is space to write *tailbits* bytes of data beyond current end of socket buffer. *trailer* will be set to point to the *skb* in which this space begins.

The number of scatterlist elements required to completely map the COW'd and extended socket buffer will be returned.

## Name

`skb_partial_csum_set` — set up and verify partial csum values for packet

## Synopsis

```
bool skb_partial_csum_set (struct sk_buff * skb, u16 start, u16 off);
```

## Arguments

*skb*      the skb to set

*start*    the number of bytes after `skb->data` to start checksumming.

*off*      the offset from *start* to place the checksum.

## Description

For untrusted partially-checksummed packets, we need to make sure the values for `skb->csum_start` and `skb->csum_offset` are valid so we don't oops.

This function checks and sets those values and `skb->ip_summed`: if this returns false you should drop the packet.

## Name

`skb_checksum_setup` — set up partial checksum offset

## Synopsis

```
int skb_checksum_setup (struct sk_buff * skb, bool recalculate);
```

## Arguments

*skb*                    the skb to set up

*recalculate*    if true the pseudo-header checksum will be recalculated

## Name

`skb_try_coalesce` — try to merge skb to prior one

## Synopsis

```
bool skb_try_coalesce (struct sk_buff * to, struct sk_buff * from, bool  
* fragstolen, int * delta_truesize);
```

## Arguments

<i>to</i>	prior buffer
<i>from</i>	buffer to add
<i>fragstolen</i>	pointer to boolean
<i>delta_truesize</i>	how much more was allocated than was requested

## Name

`skb_scrub_packet` — scrub an skb

## Synopsis

```
void skb_scrub_packet (struct sk_buff * skb, bool xnet);
```

## Arguments

*skb*     buffer to clean

*xnet*    packet is crossing netns

## Description

`skb_scrub_packet` can be used after encapsulating or decapsulating a packet into/from a tunnel. Some information have to be cleared during these operations. `skb_scrub_packet` can also be used to clean a skb before injecting it in another namespace (*xnet* == true). We have to clear all information in the skb that could impact namespace isolation.



## Name

`skb_gso_transport_seglen` — Return length of individual segments of a gso packet

## Synopsis

```
unsigned int skb_gso_transport_seglen (const struct sk_buff * skb);
```

## Arguments

*skb*    GSO skb

## Description

`skb_gso_transport_seglen` is used to determine the real size of the individual segments, including Layer4 headers (TCP/UDP).

The MAC/L2 or network (IP, IPv6) headers are not accounted for.

## Name

`sk_ns_capable` — General socket capability test

## Synopsis

```
bool sk_ns_capable (const struct sock * sk, struct user_namespace *  
user_ns, int cap);
```

## Arguments

<i>sk</i>	Socket to use a capability on or through
<i>user_ns</i>	The user namespace of the capability to use
<i>cap</i>	The capability to use

## Description

Test to see if the opener of the socket had when the socket was created and the current process has the capability *cap* in the user namespace *user\_ns*.

## Name

`sk_capable` — Socket global capability test

## Synopsis

```
bool sk_capable (const struct sock * sk, int cap);
```

## Arguments

*sk*     Socket to use a capability on or through

*cap*    The global capability to use

## Description

Test to see if the opener of the socket had when the socket was created and the current process has the capability *cap* in all user namespaces.

## Name

`sk_net_capable` — Network namespace socket capability test

## Synopsis

```
bool sk_net_capable (const struct sock * sk, int cap);
```

## Arguments

*sk*     Socket to use a capability on or through

*cap*    The capability to use

## Description

Test to see if the opener of the socket had when the socket was created and the current process has the capability *cap* over the network namespace the socket is a member of.

## Name

`sk_set_memalloc` — sets `SOCK_MEMALLOC`

## Synopsis

```
void sk_set_memalloc (struct sock * sk);
```

## Arguments

*sk*    socket to set it on

## Description

Set `SOCK_MEMALLOC` on a socket for access to emergency reserves. It's the responsibility of the admin to adjust `min_free_kbytes` to meet the requirements

## Name

`sk_alloc` — All socket objects are allocated here

## Synopsis

```
struct sock * sk_alloc (struct net * net, int family, gfp_t priority,  
struct proto * prot);
```

## Arguments

<i>net</i>	the applicable net namespace
<i>family</i>	protocol family
<i>priority</i>	for allocation (GFP_KERNEL, GFP_ATOMIC, etc)
<i>prot</i>	struct proto associated with this new sock instance

## Name

`sk_clone_lock` — clone a socket, and lock its clone

## Synopsis

```
struct sock * sk_clone_lock (const struct sock * sk, const gfp_t
priority);
```

## Arguments

*sk*            the socket to clone

*priority*    for allocation (GFP\_KERNEL, GFP\_ATOMIC, etc)

## Description

Caller must unlock socket even in error path (`bh_unlock_sock(newsk)`)

## Name

`skb_page_frag_refill` — check that a `page_frag` contains enough room

## Synopsis

```
bool skb_page_frag_refill (unsigned int sz, struct page_frag * pfrag,  
gfp_t prio);
```

## Arguments

*sz*        minimum size of the fragment we want to get

*pfrag*    pointer to `page_frag`

*prio*     priority for memory allocation

## Note

While this allocator tries to use high order pages, there is no guarantee that allocations succeed. Therefore, *sz* MUST be less or equal than `PAGE_SIZE`.



## Name

`sk_wait_data` — wait for data to arrive at `sk_receive_queue`

## Synopsis

```
int sk_wait_data (struct sock * sk, long * timeo);
```

## Arguments

*sk*        sock to wait on

*timeo*    for how long

## Description

Now socket state including `sk->sk_err` is changed only under lock, hence we may omit checks after joining wait queue. We check receive queue before `schedule` only as optimization; it is very likely that `release_sock` added new data.

## Name

`__sk_mem_schedule` — increase `sk_forward_alloc` and `memory_allocated`

## Synopsis

```
int __sk_mem_schedule (struct sock * sk, int size, int kind);
```

## Arguments

*sk*      socket

*size*    memory size to allocate

*kind*    allocation type

## Description

If `kind` is `SK_MEM_SEND`, it means `wmem` allocation. Otherwise it means `rmem` allocation. This function assumes that protocols which have `memory_pressure` use `sk_wmem_queued` as write buffer accounting.

## Name

`__sk_mem_reclaim` — reclaim memory\_allocated

## Synopsis

```
void __sk_mem_reclaim (struct sock * sk);
```

## Arguments

*sk* socket

## Name

`lock_sock_fast` — fast version of `lock_sock`

## Synopsis

```
bool lock_sock_fast (struct sock * sk);
```

## Arguments

*sk* socket

## Description

This version should be used for very small section, where process wont block return false if fast path is taken `sk_lock.slock` locked, owned = 0, BH disabled return true if slow path is taken `sk_lock.slock` unlocked, owned = 1, BH enabled

## Name

`__skb_recv_datagram` — Receive a datagram skbuff

## Synopsis

```
struct sk_buff * __skb_recv_datagram (struct sock * sk, unsigned int
flags, int * peeked, int * off, int * err);
```

## Arguments

*sk*            socket

*flags*        MSG\_ flags

*peeked*      returns non-zero if this packet has been seen before

*off*          an offset in bytes to peek skb from. Returns an offset within an skb where data actually starts

*err*          error code returned

## Description

Get a datagram skbuff, understands the peeking, nonblocking wakeups and possible races. This replaces identical code in packet, raw and udp, as well as the IPX AX.25 and Appletalk. It also finally fixes the long standing peek and read race for datagram sockets. If you alter this routine remember it must be re-entrant.

This function will lock the socket if a skb is returned, so the caller needs to unlock the socket in that case (usually by calling `skb_free_datagram`)

\* It does not lock socket since today. This function is \* free of race conditions. This measure should/ can improve \* significantly datagram socket latencies at high loads, \* when data copying to user space takes lots of time. \* (BTW I've just killed the last `cli` in IP/IPv6/core/netlink/packet \* 8) Great win.) \* --ANK (980729)

The order of the tests when we find no data waiting are specified quite explicitly by POSIX 1003.1g, don't change them without having the standard around please.

## Name

`skb_kill_datagram` — Free a datagram skbuff forcibly

## Synopsis

```
int skb_kill_datagram (struct sock * sk, struct sk_buff * skb, unsigned  
int flags);
```

## Arguments

*sk*        socket

*skb*       datagram skbuff

*flags*    MSG\_flags

## Description

This function frees a datagram skbuff that was received by `skb_recv_datagram`. The `flags` argument must match the one used for `skb_recv_datagram`.

If the `MSG_PEEK` flag is set, and the packet is still on the receive queue of the socket, it will be taken off the queue before it is freed.

This function currently only disables BH when acquiring the `sk_receive_queue` lock. Therefore it must not be used in a context where that lock is acquired in an IRQ context.

It returns 0 if the packet was removed by us.

## Name

`skb_copy_datagram_iovec` — Copy a datagram to an iovec.

## Synopsis

```
int skb_copy_datagram_iovec (const struct sk_buff * skb, int offset,  
struct iovec * to, int len);
```

## Arguments

<i>skb</i>	buffer to copy
<i>offset</i>	offset in the buffer to start copying from
<i>to</i>	io vector to copy to
<i>len</i>	amount of data to copy from buffer to iovec

## Note

the iovec is modified during the copy.

## Name

`skb_copy_datagram_const_iovec` — Copy a datagram to an iovec.

## Synopsis

```
int skb_copy_datagram_const_iovec (const struct sk_buff * skb, int
offset, const struct iovec * to, int to_offset, int len);
```

## Arguments

<i>skb</i>	buffer to copy
<i>offset</i>	offset in the buffer to start copying from
<i>to</i>	io vector to copy to
<i>to_offset</i>	offset in the io vector to start copying to
<i>len</i>	amount of data to copy from buffer to iovec

## Description

Returns 0 or -EFAULT.

## Note

the iovec is not modified during the copy.



## Name

`skb_copy_datagram_from_iovec` — Copy a datagram from an iovec.

## Synopsis

```
int skb_copy_datagram_from_iovec (struct sk_buff * skb, int offset,  
const struct iovec * from, int from_offset, int len);
```

## Arguments

<i>skb</i>	buffer to copy
<i>offset</i>	offset in the buffer to start copying to
<i>from</i>	io vector to copy to
<i>from_offset</i>	offset in the io vector to start copying from
<i>len</i>	amount of data to copy to buffer from iovec

## Description

Returns 0 or -EFAULT.

## Note

the iovec is not modified during the copy.

## Name

`zerocopy_sg_from_iovec` — Build a zerocopy datagram from an iovec

## Synopsis

```
int zerocopy_sg_from_iovec (struct sk_buff * skb, const struct iovec *  
from, int offset, size_t count);
```

## Arguments

<i>skb</i>	buffer to copy
<i>from</i>	io vector to copy from
<i>offset</i>	offset in the io vector to start copying from
<i>count</i>	amount of vectors to copy to buffer from

## Description

The function will first copy up to `headlen`, and then pin the userspace pages and build frags through them.

Returns 0, `-EFAULT` or `-EMSGSIZE`.

## Note

the iovec is not modified during the copy

## Name

`skb_copy_and_csum_datagram_iovec` — Copy and checksum skb to user iovec.

## Synopsis

```
int skb_copy_and_csum_datagram_iovec (struct sk_buff * skb, int hlen,  
struct iovec * iov);
```

## Arguments

*skb*    skbuff

*hlen*   hardware length

*iov*    io vector

## Description

Caller `_must_` check that `skb` will fit to this iovec.

## Returns

0 - success. -EINVAL - checksum failure. -EFAULT - fault during copy. Beware, in this case iovec can be modified!

## Name

`datagram_poll` — generic datagram poll

## Synopsis

```
unsigned int datagram_poll (struct file * file, struct socket * sock,  
poll_table * wait);
```

## Arguments

*file* file struct

*sock* socket

*wait* poll table

## Datagram poll

Again totally generic. This also handles sequenced packet sockets providing the socket receive queue is only ever holding data ready to receive.

## Note

when you `_don't_` use this routine for this protocol, and you use a different write policy from `sock_writeable` then please supply your own `write_space` callback.

## Name

`sk_stream_write_space` — stream socket `write_space` callback.

## Synopsis

```
void sk_stream_write_space (struct sock * sk);
```

## Arguments

*sk* socket

## FIXME

write proper description

## Name

`sk_stream_wait_connect` — Wait for a socket to get into the connected state

## Synopsis

```
int sk_stream_wait_connect (struct sock * sk, long * timeo_p);
```

## Arguments

*sk*            sock to wait on

*timeo\_p*    for how long to wait

## Description

Must be called with the socket locked.

## Name

`sk_stream_wait_memory` — Wait for more memory for a socket

## Synopsis

```
int sk_stream_wait_memory (struct sock * sk, long * timeo_p);
```

## Arguments

*sk*                socket to wait for memory

*timeo\_p*        for how long

## Socket Filter

## Name

`sk_filter` — run a packet through a socket filter

## Synopsis

```
int sk_filter (struct sock * sk, struct sk_buff * skb);
```

## Arguments

*sk*     sock associated with `sk_buff`

*skb*    buffer to filter

## Description

Run the filter code and then cut `skb->data` to correct size returned by `sk_run_filter`. If `pkt_len` is 0 we toss packet. If `skb->len` is smaller than `pkt_len` we keep whole `skb->data`. This is the socket level wrapper to `sk_run_filter`. It returns 0 if the packet should be accepted or `-EPERM` if the packet should be tossed.



## Name

`sk_chk_filter` — verify socket filter code

## Synopsis

```
int sk_chk_filter (struct sock_filter * filter, unsigned int flen);
```

## Arguments

*filter*    filter to verify

*flen*      length of filter

## Description

Check the user's filter code. If we let some ugly filter code slip through kaboom! The filter must contain no references or jumps that are out of range, no illegal instructions, and must end with a RET instruction.

All jumps are forward as they are not signed.

Returns 0 if the rule set is legal or -EINVAL if not.

## Name

`sk_filter_select_runtime` — select execution runtime for BPF program

## Synopsis

```
void sk_filter_select_runtime (struct sk_filter * fp);
```

## Arguments

*fp* sk\_filter populated with internal BPF program

## Description

try to JIT internal BPF program, if JIT is not available select interpreter BPF program will be executed via `SK_RUN_FILTER` macro

## Name

`sk_unattached_filter_create` — create an unattached filter

## Synopsis

```
int sk_unattached_filter_create (struct sk_filter ** pfp, struct
sock_fprog_kern * fprog);
```

## Arguments

*pfp*      the unattached filter that is created

*fprog*    the filter program

## Description

Create a filter independent of any socket. We first run some sanity checks on it to make sure it does not explode on us later. If an error occurs or there is insufficient memory for the filter a negative errno code is returned. On success the return is zero.

## Name

`sk_attach_filter` — attach a socket filter

## Synopsis

```
int sk_attach_filter (struct sock_fprog * fprog, struct sock * sk);
```

## Arguments

*fprog*    the filter program

*sk*        the socket to use

## Description

Attach the user's filter code. We first run some sanity checks on it to make sure it does not explode on us later. If an error occurs or there is insufficient memory for the filter a negative errno code is returned. On success the return is zero.

# Generic Network Statistics

## Name

struct gnet\_stats\_basic — byte/packet throughput statistics

## Synopsis

```
struct gnet_stats_basic {  
    __u64 bytes;  
    __u32 packets;  
};
```

## Members

bytes	number of seen bytes
packets	number of seen packets

## Name

struct gnet\_stats\_rate\_est — rate estimator

## Synopsis

```
struct gnet_stats_rate_est {  
    __u32 bps;  
    __u32 pps;  
};
```

## Members

bps    current byte rate

pps    current packet rate

## Name

struct gnet\_stats\_rate\_est64 — rate estimator

## Synopsis

```
struct gnet_stats_rate_est64 {  
    __u64 bps;  
    __u64 pps;  
};
```

## Members

bps    current byte rate

pps    current packet rate

## Name

struct gnet\_stats\_queue — queuing statistics

## Synopsis

```
struct gnet_stats_queue {  
    __u32 qlen;  
    __u32 backlog;  
    __u32 drops;  
    __u32 requeues;  
    __u32 overlimits;  
};
```

## Members

qlen	queue length
backlog	backlog size of queue
drops	number of dropped packets
requeues	number of requeues
overlimits	number of enqueues over the limit



## Name

struct gnet\_estimator — rate estimator configuration

## Synopsis

```
struct gnet_estimator {  
    signed char interval;  
    unsigned char ewma_log;  
};
```

## Members

interval	sampling period
ewma_log	the log of measurement window weight

## Name

`gnet_stats_start_copy_compat` — start dumping procedure in compatibility mode

## Synopsis

```
int gnet_stats_start_copy_compat (struct sk_buff * skb, int type, int
    tc_stats_type, int xstats_type, spinlock_t * lock, struct gnet_dump *
    d);
```

## Arguments

<i>skb</i>	socket buffer to put statistics TLVs into
<i>type</i>	TLV type for top level statistic TLV
<i>tc_stats_type</i>	TLV type for backward compatibility struct tc_stats TLV
<i>xstats_type</i>	TLV type for backward compatibility xstats TLV
<i>lock</i>	statistics lock
<i>d</i>	dumping handle

## Description

Initializes the dumping handle, grabs the statistic lock and appends an empty TLV header to the socket buffer for use a container for all other statistic TLVS.

The dumping handle is marked to be in backward compatibility mode telling all `gnet_stats_copy_XXX` functions to fill a local copy of struct `tc_stats`.

Returns 0 on success or -1 if the room in the socket buffer was not sufficient.

## Name

`gnet_stats_start_copy` — start dumping procedure in compatibility mode

## Synopsis

```
int gnet_stats_start_copy (struct sk_buff * skb, int type, spinlock_t  
* lock, struct gnet_dump * d);
```

## Arguments

*skb*     socket buffer to put statistics TLVs into

*type*    TLV type for top level statistic TLV

*lock*    statistics lock

*d*        dumping handle

## Description

Initializes the dumping handle, grabs the statistic lock and appends an empty TLV header to the socket buffer for use as a container for all other statistic TLVS.

Returns 0 on success or -1 if the room in the socket buffer was not sufficient.

## Name

`gnet_stats_copy_basic` — copy basic statistics into statistic TLV

## Synopsis

```
int    gnet_stats_copy_basic    (struct    gnet_dump    *    d,    struct
gnet_stats_basic_packed * b);
```

## Arguments

*d* dumping handle

*b* basic statistics

## Description

Appends the basic statistics to the top level TLV created by `gnet_stats_start_copy`.

Returns 0 on success or -1 with the statistic lock released if the room in the socket buffer was not sufficient.

## Name

`gnet_stats_copy_rate_est` — copy rate estimator statistics into statistics TLV

## Synopsis

```
int gnet_stats_copy_rate_est (struct gnet_dump * d, const struct
gnet_stats_basic_packed * b, struct gnet_stats_rate_est64 * r);
```

## Arguments

*d* dumping handle

*b* basic statistics

*r* rate estimator statistics

## Description

Appends the rate estimator statistics to the top level TLV created by `gnet_stats_start_copy`.

Returns 0 on success or -1 with the statistic lock released if the room in the socket buffer was not sufficient.

## Name

`gnet_stats_copy_queue` — copy queue statistics into statistics TLV

## Synopsis

```
int gnet_stats_copy_queue (struct gnet_dump * d, struct gnet_stats_queue  
* q);
```

## Arguments

*d* dumping handle

*q* queue statistics

## Description

Appends the queue statistics to the top level TLV created by `gnet_stats_start_copy`.

Returns 0 on success or -1 with the statistic lock released if the room in the socket buffer was not sufficient.

## Name

`gnet_stats_copy_app` — copy application specific statistics into statistics TLV

## Synopsis

```
int gnet_stats_copy_app (struct gnet_dump * d, void * st, int len);
```

## Arguments

*d*      dumping handle

*st*     application specific statistics data

*len*    length of data

## Description

Appends the application sepecific statistics to the top level TLV created by `gnet_stats_start_copy` and remembers the data for XSTATS if the dumping handle is in backward compatibility mode.

Returns 0 on success or -1 with the statistic lock released if the room in the socket buffer was not sufficient.

## Name

`gnet_stats_finish_copy` — finish dumping procedure

## Synopsis

```
int gnet_stats_finish_copy (struct gnet_dump * d);
```

## Arguments

*d* dumping handle

## Description

Corrects the length of the top level TLV to include all TLVs added by `gnet_stats_copy_XXX` calls. Adds the backward compatibility TLVs if `gnet_stats_start_copy_compat` was used and releases the statistics lock.

Returns 0 on success or -1 with the statistic lock released if the room in the socket buffer was not sufficient.



## Name

`gen_new_estimator` — create a new rate estimator

## Synopsis

```
int gen_new_estimator (struct gnet_stats_basic_packed * bstats, struct
gnet_stats_rate_est64 * rate_est, spinlock_t * stats_lock, struct nlattr
* opt);
```

## Arguments

<i>bstats</i>	basic statistics
<i>rate_est</i>	rate estimator statistics
<i>stats_lock</i>	statistics lock
<i>opt</i>	rate estimator configuration TLV

## Description

Creates a new rate estimator with *bstats* as source and *rate\_est* as destination. A new timer with the interval specified in the configuration TLV is created. Upon each interval, the latest statistics will be read from *bstats* and the estimated rate will be stored in *rate\_est* with the statistics lock grabbed during this period.

Returns 0 on success or a negative error code.

## Name

`gen_kill_estimator` — remove a rate estimator

## Synopsis

```
void gen_kill_estimator (struct gnet_stats_basic_packed * bstats, struct  
gnet_stats_rate_est64 * rate_est);
```

## Arguments

*bstats*      basic statistics

*rate\_est*    rate estimator statistics

## Description

Removes the rate estimator specified by *bstats* and *rate\_est*.

## Note

Caller should respect an RCU grace period before freeing *stats\_lock*

## Name

`gen_replace_estimator` — replace rate estimator configuration

## Synopsis

```
int gen_replace_estimator (struct gnet_stats_basic_packed * bstats,  
struct gnet_stats_rate_est64 * rate_est, spinlock_t * stats_lock, struct  
nlattr * opt);
```

## Arguments

<i>bstats</i>	basic statistics
<i>rate_est</i>	rate estimator statistics
<i>stats_lock</i>	statistics lock
<i>opt</i>	rate estimator configuration TLV

## Description

Replaces the configuration of a rate estimator by calling `gen_kill_estimator` and `gen_new_estimator`.

Returns 0 on success or a negative error code.

## Name

`gen_estimator_active` — test if estimator is currently in use

## Synopsis

```
bool gen_estimator_active (const struct gnet_stats_basic_packed *  
bstats, const struct gnet_stats_rate_est64 * rate_est);
```

## Arguments

*bstats*      basic statistics

*rate\_est*    rate estimator statistics

## Description

Returns true if estimator is active, and false if not.

# SUN RPC subsystem

## Name

`xdr_encode_opaque_fixed` — Encode fixed length opaque data

## Synopsis

```
__be32 * xdr_encode_opaque_fixed (__be32 * p, const void * ptr, unsigned  
int nbytes);
```

## Arguments

*p*            pointer to current position in XDR buffer.

*ptr*          pointer to data to encode (or NULL)

*nbytes*      size of data.

## Description

Copy the array of data of length *nbytes* at *ptr* to the XDR buffer at position *p*, then align to the next 32-bit boundary by padding with zero bytes (see RFC1832).

## Note

if *ptr* is NULL, only the padding is performed.

Returns the updated current XDR buffer position

## Name

`xdr_encode_opaque` — Encode variable length opaque data

## Synopsis

```
__be32 * xdr_encode_opaque (__be32 * p, const void * ptr, unsigned int  
nbytes);
```

## Arguments

*p*            pointer to current position in XDR buffer.

*ptr*          pointer to data to encode (or NULL)

*nbytes*      size of data.

## Description

Returns the updated current XDR buffer position

## Name

`xdr_terminate_string` — '\0'-terminate a string residing in an `xdr_buf`

## Synopsis

```
void xdr_terminate_string (struct xdr_buf * buf, const u32 len);
```

## Arguments

*buf*    XDR buffer where string resides

*len*    length of string, in bytes

## Name

`_copy_from_pages` —

## Synopsis

```
void _copy_from_pages (char * p, struct page ** pages, size_t pgbase,  
size_t len);
```

## Arguments

*p*            pointer to destination

*pages*       array of pages

*pgbase*      offset of source data

*len*         length

## Description

Copies data into an arbitrary memory location from an array of pages. The copy is assumed to be non-overlapping.



## Name

`xdr_stream_pos` — Return the current offset from the start of the `xdr_stream`

## Synopsis

```
unsigned int xdr_stream_pos (const struct xdr_stream * xdr);
```

## Arguments

*xdr* pointer to struct `xdr_stream`

## Name

`xdr_init_encode` — Initialize a struct `xdr_stream` for sending data.

## Synopsis

```
void xdr_init_encode (struct xdr_stream * xdr, struct xdr_buf * buf,  
__be32 * p);
```

## Arguments

*xdr* pointer to `xdr_stream` struct

*buf* pointer to XDR buffer in which to encode data

*p* current pointer inside XDR buffer

## Note

at the moment the RPC client only passes the length of our scratch buffer in the `xdr_buf`'s header `kvec`. Previously this meant we needed to call `xdr_adjust_iovec` after encoding the data. With the new scheme, the `xdr_stream` manages the details of the buffer length, and takes care of adjusting the `kvec` length for us.

## Name

`xdr_commit_encode` — Ensure all data is written to buffer

## Synopsis

```
void xdr_commit_encode (struct xdr_stream * xdr);
```

## Arguments

*xdr* pointer to `xdr_stream`

## Description

We handle encoding across page boundaries by giving the caller a temporary location to write to, then later copying the data into place; `xdr_commit_encode` does that copying.

Normally the caller doesn't need to call this directly, as the following `xdr_reserve_space` will do it. But an explicit call may be required at the end of encoding, or any other time when the `xdr_buf` data might be read.

## Name

`xdr_reserve_space` — Reserve buffer space for sending

## Synopsis

```
__be32 * xdr_reserve_space (struct xdr_stream * xdr, size_t nbytes);
```

## Arguments

*xdr*       pointer to `xdr_stream`

*nbytes*   number of bytes to reserve

## Description

Checks that we have enough buffer space to encode 'nbytes' more bytes of data. If so, update the total `xdr_buf` length, and adjust the length of the current kvec.

## Name

`xdr_truncate_encode` — truncate an encode buffer

## Synopsis

```
void xdr_truncate_encode (struct xdr_stream * xdr, size_t len);
```

## Arguments

*xdr* pointer to `xdr_stream`

*len* new length of buffer

## Description

Truncates the xdr stream, so that `xdr->buf->len == len`, and `xdr->p` points at offset `len` from the start of the buffer, and head, tail, and page lengths are adjusted to correspond.

If this means moving `xdr->p` to a different buffer, we assume that that the end pointer should be set to the end of the current page, except in the case of the head buffer when we assume the head buffer's current length represents the end of the available buffer.

This is *\*not\** safe to use on a buffer that already has inlined page cache pages (as in a zero-copy server read reply), except for the simple case of truncating from one position in the tail to another.

## Name

`xdr_restrict_buflen` — decrease available buffer space

## Synopsis

```
int xdr_restrict_buflen (struct xdr_stream * xdr, int newbuflen);
```

## Arguments

*xdr*                pointer to `xdr_stream`

*newbuflen*        new maximum number of bytes available

## Description

Adjust our idea of how much space is available in the buffer. If we've already used too much space in the buffer, returns -1. If the available space is already smaller than `newbuflen`, returns 0 and does nothing. Otherwise, adjusts `xdr->buf->buflen` to `newbuflen` and ensures `xdr->end` is set at most offset `newbuflen` from the start of the buffer.

## Name

`xdr_write_pages` — Insert a list of pages into an XDR buffer for sending

## Synopsis

```
void xdr_write_pages (struct xdr_stream * xdr, struct page ** pages,  
unsigned int base, unsigned int len);
```

## Arguments

*xdr*      pointer to `xdr_stream`

*pages*   list of pages

*base*    offset of first byte

*len*     length of data in bytes

## Name

`xdr_init_decode` — Initialize an `xdr_stream` for decoding data.

## Synopsis

```
void xdr_init_decode (struct xdr_stream * xdr, struct xdr_buf * buf,  
__be32 * p);
```

## Arguments

*xdr* pointer to `xdr_stream` struct

*buf* pointer to XDR buffer from which to decode data

*p* current pointer inside XDR buffer



## Name

`xdr_init_decode_pages` — Initialize an `xdr_stream` for decoding data.

## Synopsis

```
void xdr_init_decode_pages (struct xdr_stream * xdr, struct xdr_buf *  
buf, struct page ** pages, unsigned int len);
```

## Arguments

<i>xdr</i>	pointer to <code>xdr_stream</code> struct
<i>buf</i>	pointer to XDR buffer from which to decode data
<i>pages</i>	list of pages to decode into
<i>len</i>	length in bytes of buffer in pages

## Name

`xdr_set_scratch_buffer` — Attach a scratch buffer for decoding data.

## Synopsis

```
void xdr_set_scratch_buffer (struct xdr_stream * xdr, void * buf, size_t  
buflen);
```

## Arguments

*xdr*       pointer to `xdr_stream` struct

*buf*       pointer to an empty buffer

*buflen*   size of 'buf'

## Description

The scratch buffer is used when decoding from an array of pages. If an `xdr_inline_decode` call spans across page boundaries, then we copy the data into the scratch buffer in order to allow linear access.

## Name

`xdr_inline_decode` — Retrieve XDR data to decode

## Synopsis

```
__be32 * xdr_inline_decode (struct xdr_stream * xdr, size_t nbytes);
```

## Arguments

*xdr*       pointer to `xdr_stream` struct

*nbytes*   number of bytes of data to decode

## Description

Check if the input buffer is long enough to enable us to decode 'nbytes' more bytes of data starting at the current position. If so return the current pointer, then update the current pointer position.

## Name

`xdr_read_pages` — Ensure page-based XDR data to decode is aligned at current pointer position

## Synopsis

```
unsigned int xdr_read_pages (struct xdr_stream * xdr, unsigned int len);
```

## Arguments

*xdr* pointer to `xdr_stream` struct

*len* number of bytes of page data

## Description

Moves data beyond the current pointer position from the XDR `head[]` buffer into the page list. Any data that lies beyond current position + “len” bytes is moved into the XDR `tail[]`.

Returns the number of XDR encoded bytes now contained in the pages

## Name

`xdr_enter_page` — decode data from the XDR page

## Synopsis

```
void xdr_enter_page (struct xdr_stream * xdr, unsigned int len);
```

## Arguments

*xdr*   pointer to `xdr_stream` struct

*len*   number of bytes of page data

## Description

Moves data beyond the current pointer position from the XDR `head[]` buffer into the page list. Any data that lies beyond current position + “len” bytes is moved into the XDR `tail[]`. The current pointer is then repositioned at the beginning of the first XDR page.

## Name

`xdr_buf_subsegment` — set `subbuf` to a portion of `buf`

## Synopsis

```
int xdr_buf_subsegment (struct xdr_buf * buf, struct xdr_buf * subbuf,
unsigned int base, unsigned int len);
```

## Arguments

<i>buf</i>	an xdr buffer
<i>subbuf</i>	the result buffer
<i>base</i>	beginning of range in bytes
<i>len</i>	length of range in bytes

## Description

sets *subbuf* to an xdr buffer representing the portion of *buf* of length *len* starting at offset *base*.

*buf* and *subbuf* may be pointers to the same struct `xdr_buf`.

Returns -1 if *base* or *length* are out of bounds.

## Name

`xdr_buf_trim` — lop at most “len” bytes off the end of “buf”

## Synopsis

```
void xdr_buf_trim (struct xdr_buf * buf, unsigned int len);
```

## Arguments

*buf*    buf to be trimmed

*len*    number of bytes to reduce “buf” by

## Description

Trim an `xdr_buf` by the given number of bytes by fixing up the lengths. Note that it's possible that we'll trim less than that amount if the `xdr_buf` is too small, or if (for instance) it's all in the head and the parser has already read too far into it.

## Name

`svc_print_addr` — Format `rq_addr` field for printing

## Synopsis

```
char * svc_print_addr (struct svc_rqst * rqstp, char * buf, size_t len);
```

## Arguments

*rqstp*    `svc_rqst` struct containing address to print

*buf*     target buffer for formatted address

*len*     length of target buffer



## Name

`svc_reserve` — change the space reserved for the reply to a request.

## Synopsis

```
void svc_reserve (struct svc_rqst * rqstp, int space);
```

## Arguments

*rqstp*    The request in question

*space*    new max space to reserve

## Description

Each request reserves some space on the output queue of the transport to make sure the reply fits. This function reduces that reserved space to be the amount of space used already, plus *space*.

## Name

`svc_find_xprt` — find an RPC transport instance

## Synopsis

```
struct svc_xprt * svc_find_xprt (struct svc_serv * serv, const char *  
xcl_name, struct net * net, const sa_family_t af, const unsigned short  
port);
```

## Arguments

<i>serv</i>	pointer to <code>svc_serv</code> to search
<i>xcl_name</i>	C string containing transport's class name
<i>net</i>	owner net pointer
<i>af</i>	Address family of transport's local address
<i>port</i>	transport's IP port number

## Description

Return the transport instance pointer for the endpoint accepting connections/peer traffic from the specified transport class, address family and port.

Specifying 0 for the address family or port is effectively a wild-card, and will result in matching the first transport in the service's list that has a matching class name.

## Name

`svc_xprt_names` — format a buffer with a list of transport names

## Synopsis

```
int svc_xprt_names (struct svc_serv * serv, char * buf, const int  
buflen);
```

## Arguments

*serv*      pointer to an RPC service

*buf*       pointer to a buffer to be filled in

*buflen*   length of buffer to be filled in

## Description

Fills in *buf* with a string containing a list of transport names, each name terminated with '\n'.

Returns positive length of the filled-in string on success; otherwise a negative errno value is returned if an error occurs.

## Name

`xprt_register_transport` — register a transport implementation

## Synopsis

```
int xprt_register_transport (struct xprt_class * transport);
```

## Arguments

*transport*    transport to register

## Description

If a transport implementation is loaded as a kernel module, it can call this interface to make itself known to the RPC client.

## 0

transport successfully registered -EEXIST: transport already registered -EINVAL: transport module being unloaded

## Name

`xprt_unregister_transport` — unregister a transport implementation

## Synopsis

```
int xprt_unregister_transport (struct xprt_class * transport);
```

## Arguments

*transport*    transport to unregister

## 0

transport successfully unregistered -ENOENT: transport never registered

## Name

`xprt_load_transport` — load a transport implementation

## Synopsis

```
int xprt_load_transport (const char * transport_name);
```

## Arguments

*transport\_name*    transport to load

## 0

transport successfully loaded -ENOENT: transport module not available

## Name

`xprt_reserve_xprt` — serialize write access to transports

## Synopsis

```
int xprt_reserve_xprt (struct rpc_xprt * xprt, struct rpc_task * task);
```

## Arguments

*xprt* pointer to the target transport

*task* task that is requesting access to the transport

## Description

This prevents mixing the payload of separate requests, and prevents transport connects from colliding with writes. No congestion control is provided.

## Name

`xprt_release_xprt` — allow other requests to use a transport

## Synopsis

```
void xprt_release_xprt (struct rpc_xprt * xprt, struct rpc_task * task);
```

## Arguments

*xprt* transport with other tasks potentially waiting

*task* task that is releasing access to the transport

## Description

Note that “task” can be NULL. No congestion control is provided.



## Name

`xprt_release_xprt_cong` — allow other requests to use a transport

## Synopsis

```
void xprt_release_xprt_cong (struct rpc_xprt * xprt, struct rpc_task  
* task);
```

## Arguments

*xprt* transport with other tasks potentially waiting

*task* task that is releasing access to the transport

## Description

Note that “task” can be NULL. Another task is awoken to use the transport if the transport's congestion window allows it.

## Name

`xprt_release_rqst_cong` — housekeeping when request is complete

## Synopsis

```
void xprt_release_rqst_cong (struct rpc_task * task);
```

## Arguments

*task* RPC request that recently completed

## Description

Useful for transports that require congestion control.

## Name

`xprt_adjust_cwnd` — adjust transport congestion window

## Synopsis

```
void xprt_adjust_cwnd (struct rpc_xprt * xprt, struct rpc_task * task,  
int result);
```

## Arguments

*xprt*      pointer to `xprt`

*task*      recently completed RPC request used to adjust window

*result*    result code of completed RPC request

## Description

The transport code maintains an estimate on the maximum number of out- standing RPC requests, using a smoothed version of the congestion avoidance implemented in 44BSD. This is basically the Van Jacobson

## congestion algorithm

If a retransmit occurs, the congestion window is halved; otherwise, it is incremented by  $1/cwnd$  when

- a reply is received and - a full number of requests are outstanding and - the congestion window hasn't been updated recently.

## Name

`xprt_wake_pending_tasks` — wake all tasks on a transport's pending queue

## Synopsis

```
void xprt_wake_pending_tasks (struct rpc_xprt * xprt, int status);
```

## Arguments

*xprt*      transport with waiting tasks

*status*    result code to plant in each task before waking it

## Name

`xprt_wait_for_buffer_space` — wait for transport output buffer to clear

## Synopsis

```
void xprt_wait_for_buffer_space (struct rpc_task * task, rpc_action  
action);
```

## Arguments

*task*      task to be put to sleep

*action*    function pointer to be executed after wait

## Description

Note that we only set the timer for the case of `RPC_IS_SOFT`, since we don't in general want to force a socket disconnection due to an incomplete RPC call transmission.

## Name

`xprt_write_space` — wake the task waiting for transport output buffer space

## Synopsis

```
void xprt_write_space (struct rpc_xprt * xprt);
```

## Arguments

*xprt* transport with waiting tasks

## Description

Can be called in a soft IRQ context, so `xprt_write_space` never sleeps.

## Name

`xprt_set_retrans_timeout_def` — set a request's retransmit timeout

## Synopsis

```
void xprt_set_retrans_timeout_def (struct rpc_task * task);
```

## Arguments

*task* task whose timeout is to be set

## Description

Set a request's retransmit timeout based on the transport's default timeout parameters. Used by transports that don't adjust the retransmit timeout based on round-trip time estimation.

## Name

`xprt_set_retrans_timeout_rtt` — set a request's retransmit timeout

## Synopsis

```
void xprt_set_retrans_timeout_rtt (struct rpc_task * task);
```

## Arguments

*task* task whose timeout is to be set

## Description

Set a request's retransmit timeout using the RTT estimator.



## Name

`xprt_disconnect_done` — mark a transport as disconnected

## Synopsis

```
void xprt_disconnect_done (struct rpc_xprt * xprt);
```

## Arguments

*xprt*    transport to flag for disconnect

## Name

`xprt_lookup_rqst` — find an RPC request corresponding to an XID

## Synopsis

```
struct rpc_rqst * xprt_lookup_rqst (struct rpc_xprt * xprt, __be32 xid);
```

## Arguments

*xprt*    transport on which the original request was transmitted

*xid*    RPC XID of incoming reply

## Name

`xprt_complete_rqst` — called when reply processing is complete

## Synopsis

```
void xprt_complete_rqst (struct rpc_task * task, int copied);
```

## Arguments

*task*      RPC request that recently completed

*copied*    actual number of bytes received from the transport

## Description

Caller holds transport lock.

## Name

`rpc_wake_up` — wake up all `rpc_tasks`

## Synopsis

```
void rpc_wake_up (struct rpc_wait_queue * queue);
```

## Arguments

*queue* `rpc_wait_queue` on which the tasks are sleeping

## Description

Grabs `queue->lock`

## Name

`rpc_wake_up_status` — wake up all `rpc_tasks` and set their status value.

## Synopsis

```
void rpc_wake_up_status (struct rpc_wait_queue * queue, int status);
```

## Arguments

*queue*     `rpc_wait_queue` on which the tasks are sleeping

*status*    status value to set

## Description

Grabs `queue->lock`

## Name

`rpc_malloc` — allocate an RPC buffer

## Synopsis

```
void * rpc_malloc (struct rpc_task * task, size_t size);
```

## Arguments

*task* RPC task that will use this buffer

*size* requested byte size

## Description

To prevent `rpciod` from hanging, this allocator never sleeps, returning `NULL` and suppressing warning if the request cannot be serviced immediately. The caller can arrange to sleep in a way that is safe for `rpciod`.

Most requests are 'small' (under 2KiB) and can be serviced from a mempool, ensuring that NFS reads and writes can always proceed, and that there is good locality of reference for these buffers.

In order to avoid memory starvation triggering more writebacks of NFS requests, we avoid using `GFP_KERNEL`.

## Name

`rpc_free` — free buffer allocated via `rpc_malloc`

## Synopsis

```
void rpc_free (void * buffer);
```

## Arguments

*buffer*    buffer to free

## Name

`xdr_skb_read_bits` — copy some data bits from skb to internal buffer

## Synopsis

```
size_t xdr_skb_read_bits (struct xdr_skb_reader * desc, void * to,  
size_t len);
```

## Arguments

*desc* sk\_buff copy helper

*to* copy destination

*len* number of bytes to copy

## Description

Possibly called several times to iterate over an sk\_buff and copy data out of it.



## Name

`xdr_partial_copy_from_skb` — copy data out of an skb

## Synopsis

```
ssize_t xdr_partial_copy_from_skb (struct xdr_buf * xdr, unsigned int  
base, struct xdr_skb_reader * desc, xdr_skb_read_actor copy_actor);
```

## Arguments

<i>xdr</i>	target XDR buffer
<i>base</i>	starting offset
<i>desc</i>	sk_buff copy helper
<i>copy_actor</i>	virtual method for copying data

## Name

`csum_partial_copy_to_xdr` — checksum and copy data

## Synopsis

```
int csum_partial_copy_to_xdr (struct xdr_buf * xdr, struct sk_buff *  
skb);
```

## Arguments

*xdr* target XDR buffer

*skb* source skb

## Description

We have set things up such that we perform the checksum of the UDP packet in parallel with the copies into the RPC client iovec. -DaveM

## Name

`rpc_alloc_iostats` — allocate an `rpc_iostats` structure

## Synopsis

```
struct rpc_iostats * rpc_alloc_iostats (struct rpc_clnt * clnt);
```

## Arguments

*clnt* RPC program, version, and xprt

## Name

`rpc_free_iostats` — release an `rpc_iostats` structure

## Synopsis

```
void rpc_free_iostats (struct rpc_iostats * stats);
```

## Arguments

*stats*   doomed `rpc_iostats` structure

## Name

`rpc_count_iostats` — tally up per-task stats

## Synopsis

```
void rpc_count_iostats (const struct rpc_task * task, struct rpc_iostats  
* stats);
```

## Arguments

*task*    completed `rpc_task`

*stats*   array of stat structures

## Description

Relies on the caller for serialization.

## Name

`rpc_queue_upcall` — queue an upcall message to userspace

## Synopsis

```
int rpc_queue_upcall (struct rpc_pipe * pipe, struct rpc_pipe_msg *  
msg);
```

## Arguments

*pipe*    upcall pipe on which to queue given message

*msg*    message to queue

## Description

Call with an *inode* created by `rpc_mkpipe` to queue an upcall. A userspace process may then later read the upcall by performing a read on an open file for this inode. It is up to the caller to initialize the fields of *msg* (other than *msg->list*) appropriately.

## Name

`rpc_mkpipe_dentry` — make an `rpc_pipefs` file for kernel<->userspace communication

## Synopsis

```
struct dentry * rpc_mkpipe_dentry (struct dentry * parent, const char  
* name, void * private, struct rpc_pipe * pipe);
```

## Arguments

<i>parent</i>	dentry of directory to create new “pipe” in
<i>name</i>	name of pipe
<i>private</i>	private data to associate with the pipe, for the caller's use
<i>pipe</i>	<code>rpc_pipe</code> containing input parameters

## Description

Data is made available for userspace to read by calls to `rpc_queue_upcall`. The actual reads will result in calls to `ops->upcall`, which will be called with the file pointer, message, and userspace buffer to copy to.

Writes can come at any time, and do not necessarily have to be responses to upcalls. They will result in calls to `msg->downcall`.

The *private* argument passed here will be available to all these methods from the file pointer, via `RPC_I(file_inode(file))->private`.

## Name

`rpc_unlink` — remove a pipe

## Synopsis

```
int rpc_unlink (struct dentry * dentry);
```

## Arguments

*dentry* dentry for the pipe, as returned from `rpc_mkpipe`

## Description

After this call, lookups will no longer find the pipe, and any attempts to read or write using preexisting opens of the pipe will return `-EPIPE`.



## Name

`rpc_init_pipe_dir_head` — initialise a struct `rpc_pipe_dir_head`

## Synopsis

```
void rpc_init_pipe_dir_head (struct rpc_pipe_dir_head * pdh);
```

## Arguments

*pdh* pointer to struct `rpc_pipe_dir_head`

## Name

`rpc_init_pipe_dir_object` — initialise a struct `rpc_pipe_dir_object`

## Synopsis

```
void rpc_init_pipe_dir_object (struct rpc_pipe_dir_object * pdo, const  
struct rpc_pipe_dir_object_ops * pdo_ops, void * pdo_data);
```

## Arguments

<i>pdo</i>	pointer to struct <code>rpc_pipe_dir_object</code>
<i>pdo_ops</i>	pointer to const struct <code>rpc_pipe_dir_object_ops</code>
<i>pdo_data</i>	pointer to caller-defined data

## Name

`rpc_add_pipe_dir_object` — associate a `rpc_pipe_dir_object` to a directory

## Synopsis

```
int rpc_add_pipe_dir_object (struct net * net, struct rpc_pipe_dir_head  
* pdh, struct rpc_pipe_dir_object * pdo);
```

## Arguments

*net* pointer to struct net

*pdh* pointer to struct rpc\_pipe\_dir\_head

*pdo* pointer to struct rpc\_pipe\_dir\_object

## Name

`rpc_remove_pipe_dir_object` — remove a `rpc_pipe_dir_object` from a directory

## Synopsis

```
void    rpc_remove_pipe_dir_object    (struct net    *    net,    struct
rpc_pipe_dir_head * pdh, struct rpc_pipe_dir_object * pdo);
```

## Arguments

*net* pointer to struct net

*pdh* pointer to struct rpc\_pipe\_dir\_head

*pdo* pointer to struct rpc\_pipe\_dir\_object

## Name

`rpc_find_or_alloc_pipe_dir_object` —

## Synopsis

```
struct rpc_pipe_dir_object * rpc_find_or_alloc_pipe_dir_object (struct
net * net, struct rpc_pipe_dir_head * pdh, int (*match) (struct
rpc_pipe_dir_object *, void *), struct rpc_pipe_dir_object *(*alloc)
(void *), void * data);
```

## Arguments

<i>net</i>	pointer to struct net
<i>pdh</i>	pointer to struct rpc_pipe_dir_head
<i>match</i>	match struct rpc_pipe_dir_object to data
<i>alloc</i>	allocate a new struct rpc_pipe_dir_object
<i>data</i>	user defined data for match and alloc

## Name

`rpcb_getport_async` — obtain the port for a given RPC service on a given host

## Synopsis

```
void rpcb_getport_async (struct rpc_task * task);
```

## Arguments

*task* task that is waiting for portmapper request

## Description

This one can be called for an ongoing RPC request, and can be used in an async (rpciod) context.

## Name

`rpc_create` — create an RPC client and transport with one call

## Synopsis

```
struct rpc_clnt * rpc_create (struct rpc_create_args * args);
```

## Arguments

*args*    `rpc_clnt` create argument structure

## Description

Creates and initializes an RPC transport and an RPC client.

It can ping the server in order to determine if it is up, and to see if it supports this program and version. `RPC_CLNT_CREATE_NOPING` disables this behavior so asynchronous tasks can also use `rpc_create`.

## Name

`rpc_clone_client` — Clone an RPC client structure

## Synopsis

```
struct rpc_clnt * rpc_clone_client (struct rpc_clnt * clnt);
```

## Arguments

*clnt* RPC client whose parameters are copied

## Description

Returns a fresh RPC client or an `ERR_PTR`.



## Name

`rpc_clone_client_set_auth` — Clone an RPC client structure and set its auth

## Synopsis

```
struct rpc_clnt * rpc_clone_client_set_auth (struct rpc_clnt * clnt,  
rpc_authflavor_t flavor);
```

## Arguments

*clnt*      RPC client whose parameters are copied

*flavor*   security flavor for new client

## Description

Returns a fresh RPC client or an ERR\_PTR.

## Name

`rpc_switch_client_transport` —

## Synopsis

```
int  rpc_switch_client_transport (struct rpc_clnt * clnt, struct
xprt_create * args, const struct rpc_timeout * timeout);
```

## Arguments

*clnt*        pointer to a struct `rpc_clnt`

*args*        pointer to the new transport arguments

*timeout*    pointer to the new timeout parameters

## Description

This function allows the caller to switch the RPC transport for the `rpc_clnt` structure '`clnt`' to allow it to connect to a mirrored NFS server, for instance. It assumes that the caller has ensured that there are no active RPC tasks by using some form of locking.

Returns zero if “`clnt`” is now using the new `xprt`. Otherwise a negative `errno` is returned, and “`clnt`” continues to use the old `xprt`.

## Name

`rpc_bind_new_program` — bind a new RPC program to an existing client

## Synopsis

```
struct rpc_clnt * rpc_bind_new_program (struct rpc_clnt * old, const  
struct rpc_program * program, u32 vers);
```

## Arguments

*old*        old `rpc_client`

*program*   `rpc` program to set

*vers*       `rpc` program version

## Description

Clones the `rpc` client and sets up a new `RPC` program. This is mainly of use for enabling different `RPC` programs to share the same transport. The Sun NFSv2/v3 ACL protocol can do this.

## Name

`rpc_run_task` — Allocate a new RPC task, then run `rpc_execute` against it

## Synopsis

```
struct rpc_task * rpc_run_task (const struct rpc_task_setup *  
task_setup_data);
```

## Arguments

*task\_setup\_data* pointer to task initialisation data

## Name

`rpc_call_sync` — Perform a synchronous RPC call

## Synopsis

```
int rpc_call_sync (struct rpc_clnt * clnt, const struct rpc_message *  
msg, int flags);
```

## Arguments

*clnt*     pointer to RPC client

*msg*     RPC call parameters

*flags*   RPC call flags

## Name

`rpc_call_async` — Perform an asynchronous RPC call

## Synopsis

```
int rpc_call_async (struct rpc_clnt * clnt, const struct rpc_message *  
msg, int flags, const struct rpc_call_ops * tk_ops, void * data);
```

## Arguments

<i>clnt</i>	pointer to RPC client
<i>msg</i>	RPC call parameters
<i>flags</i>	RPC call flags
<i>tk_ops</i>	RPC call ops
<i>data</i>	user call data

## Name

`rpc_peeraddr` — extract remote peer address from `clnt`'s `xprt`

## Synopsis

```
size_t rpc_peeraddr (struct rpc_clnt * clnt, struct sockaddr * buf,  
size_t bufsize);
```

## Arguments

<i>clnt</i>	RPC client structure
<i>buf</i>	target buffer
<i>bufsize</i>	length of target buffer

## Description

Returns the number of bytes that are actually in the stored address.

## Name

`rpc_peeraddr2str` — return remote peer address in printable format

## Synopsis

```
const char * rpc_peeraddr2str (struct rpc_clnt * clnt, enum  
rpc_display_format_t format);
```

## Arguments

*clnt*      RPC client structure

*format*   address format

## NB

the lifetime of the memory referenced by the returned pointer is the same as the `rpc_xprt` itself. As long as the caller uses this pointer, it must hold the RCU read lock.



## Name

`rpc_localaddr` — discover local endpoint address for an RPC client

## Synopsis

```
int rpc_localaddr (struct rpc_clnt * clnt, struct sockaddr * buf, size_t  
buflen);
```

## Arguments

*clnt*      RPC client structure

*buf*        target buffer

*buflen*    size of target buffer, in bytes

## Description

Returns zero and fills in “buf” and “buflen” if successful; otherwise, a negative errno is returned.

This works even if the underlying transport is not currently connected, or if the upper layer never previously provided a source address.

## The result of this function call is transient

multiple calls in succession may give different results, depending on how local networking configuration changes over time.

## Name

`rpc_protocol` — Get transport protocol number for an RPC client

## Synopsis

```
int rpc_protocol (struct rpc_clnt * clnt);
```

## Arguments

*clnt*   RPC client to query

## Name

`rpc_net_ns` — Get the network namespace for this RPC client

## Synopsis

```
struct net * rpc_net_ns (struct rpc_clnt * clnt);
```

## Arguments

*clnt*    RPC client to query

## Name

`rpc_max_payload` — Get maximum payload size for a transport, in bytes

## Synopsis

```
size_t rpc_max_payload (struct rpc_clnt * clnt);
```

## Arguments

*clnt*   RPC client to query

## Description

For stream transports, this is one RPC record fragment (see RFC 1831), as we don't support multi-record requests yet. For datagram transports, this is the size of an IP packet minus the IP, UDP, and RPC header sizes.

## Name

`rpc_get_timeout` — Get timeout for transport in units of HZ

## Synopsis

```
unsigned long rpc_get_timeout (struct rpc_clnt * clnt);
```

## Arguments

*clnt*    RPC client to query

## Name

`rpc_force_rebind` — force transport to check that remote port is unchanged

## Synopsis

```
void rpc_force_rebind (struct rpc_clnt * clnt);
```

## Arguments

*clnt*    client to rebind

## WiMAX

## Name

`wimax_msg_alloc` — Create a new skb for sending a message to userspace

## Synopsis

```
struct sk_buff * wimax_msg_alloc (struct wimax_dev * wimax_dev, const  
char * pipe_name, const void * msg, size_t size, gfp_t gfp_flags);
```

## Arguments

*wimax\_dev*    WiMAX device descriptor

*pipe\_name*    "named pipe" the message will be sent to

*msg*           pointer to the message data to send

*size*           size of the message to send (in bytes), including the header.

*gfp\_flags*    flags for memory allocation.

## Returns

0 if ok, negative errno code on error

## Description

Allocates an skb that will contain the message to send to user space over the messaging pipe and initializes it, copying the payload.

Once this call is done, you can deliver it with `wimax_msg_send`.

## IMPORTANT

Don't use `skb_push/skb_pull/skb_reserve` on the skb, as `wimax_msg_send` depends on `skb->data` being placed at the beginning of the user message.

Unlike other WiMAX stack calls, this call can be used way early, even before `wimax_dev_add` is called, as long as the `wimax_dev->net_dev` pointer is set to point to a proper `net_dev`. This is so that drivers can use it early in case they need to send stuff around or communicate with user space.

## Name

`wimax_msg_data_len` — Return a pointer and size of a message's payload

## Synopsis

```
const void * wimax_msg_data_len (struct sk_buff * msg, size_t * size);
```

## Arguments

*msg*     Pointer to a message created with `wimax_msg_alloc`

*size*    Pointer to where to store the message's size

## Description

Returns the pointer to the message data.



## Name

`wimax_msg_data` — Return a pointer to a message's payload

## Synopsis

```
const void * wimax_msg_data (struct sk_buff * msg);
```

## Arguments

*msg* Pointer to a message created with `wimax_msg_alloc`

## Name

`wimax_msg_len` — Return a message's payload length

## Synopsis

```
ssize_t wimax_msg_len (struct sk_buff * msg);
```

## Arguments

*msg* Pointer to a message created with `wimax_msg_alloc`

## Name

`wimax_msg_send` — Send a pre-allocated message to user space

## Synopsis

```
int wimax_msg_send (struct wimax_dev * wimax_dev, struct sk_buff * skb);
```

## Arguments

*wimax\_dev*    WiMAX device descriptor

*skb*            struct sk\_buff returned by `wimax_msg_alloc`. Note the ownership of *skb* is transferred to this function.

## Returns

0 if ok, < 0 errno code on error

## Description

Sends a free-form message that was preallocated with `wimax_msg_alloc` and filled up.

Assumes that once you pass an *skb* to this function for sending, it owns it and will release it when done (on success).

## IMPORTANT

Don't use `skb_push/skb_pull/skb_reserve` on the *skb*, as `wimax_msg_send` depends on *skb->data* being placed at the beginning of the user message.

Unlike other WiMAX stack calls, this call can be used way early, even before `wimax_dev_add` is called, as long as the `wimax_dev->net_dev` pointer is set to point to a proper `net_dev`. This is so that drivers can use it early in case they need to send stuff around or communicate with user space.

## Name

`wimax_msg` — Send a message to user space

## Synopsis

```
int wimax_msg (struct wimax_dev * wimax_dev, const char * pipe_name,  
const void * buf, size_t size, gfp_t gfp_flags);
```

## Arguments

*wimax\_dev*    WiMAX device descriptor (properly referenced)

*pipe\_name*    "named pipe" the message will be sent to

*buf*            pointer to the message to send.

*size*            size of the buffer pointed to by *buf* (in bytes).

*gfp\_flags*    flags for memory allocation.

## Returns

0 if ok, negative errno code on error.

## Description

Sends a free-form message to user space on the device *wimax\_dev*.

## NOTES

Once the *skb* is given to this function, who will own it and will release it when done (unless it returns error).

## Name

wimax\_reset — Reset a WiMAX device

## Synopsis

```
int wimax_reset (struct wimax_dev * wimax_dev);
```

## Arguments

*wimax\_dev*    WiMAX device descriptor

## Returns

0 if ok and a warm reset was done (the device still exists in the system).

-ENODEV if a cold/bus reset had to be done (device has disconnected and reconnected, so current handle is not valid any more).

-EINVAL if the device is not even registered.

Any other negative error code shall be considered as non-recoverable.

## Description

Called when wanting to reset the device for any reason. Device is taken back to power on status.

This call blocks; on successful return, the device has completed the reset process and is ready to operate.

## Name

`wimax_report_rfkill_hw` — Reports changes in the hardware RF switch

## Synopsis

```
void wimax_report_rfkill_hw (struct wimax_dev * wimax_dev, enum  
wimax_rf_state state);
```

## Arguments

*wimax\_dev*    WiMAX device descriptor

*state*        New state of the RF Kill switch. WIMAX\_RF\_ON radio on, WIMAX\_RF\_OFF radio off.

## Description

When the device detects a change in the state of the hardware RF switch, it must call this function to let the WiMAX kernel stack know that the state has changed so it can be properly propagated.

The WiMAX stack caches the state (the driver doesn't need to). As well, as the change is propagated it will come back as a request to change the software state to mirror the hardware state.

If the device doesn't have a hardware kill switch, just report it on initialization as always on (WIMAX\_RF\_ON, radio on).

## Name

`wimax_report_rfkill_sw` — Reports changes in the software RF switch

## Synopsis

```
void wimax_report_rfkill_sw (struct wimax_dev * wimax_dev, enum
wimax_rf_state state);
```

## Arguments

*wimax\_dev*    WiMAX device descriptor

*state*        New state of the RF kill switch. `WIMAX_RF_ON` radio on, `WIMAX_RF_OFF` radio off.

## Description

Reports changes in the software RF switch state to the the WiMAX stack.

The main use is during initialization, so the driver can query the device for its current software radio kill switch state and feed it to the system.

On the side, the device does not change the software state by itself. In practice, this can happen, as the device might decide to switch (in software) the radio off for different reasons.

## Name

`wimax_rfkill` — Set the software RF switch state for a WiMAX device

## Synopsis

```
int wimax_rfkill (struct wimax_dev * wimax_dev, enum wimax_rf_state  
state);
```

## Arguments

*wimax\_dev*    WiMAX device descriptor

*state*        New RF state.

## Returns

$\geq 0$  toggle state if ok,  $< 0$  errno code on error. The toggle state is returned as a bitmap, bit 0 being the hardware RF state, bit 1 the software RF state.

0 means disabled (`WIMAX_RF_ON`, radio on), 1 means enabled radio off (`WIMAX_RF_OFF`).

## Description

Called by the user when he wants to request the WiMAX radio to be switched on (`WIMAX_RF_ON`) or off (`WIMAX_RF_OFF`). With `WIMAX_RF_QUERY`, just the current state is returned.

## NOTE

This call will block until the operation is complete.



## Name

`wimax_state_change` — Set the current state of a WiMAX device

## Synopsis

```
void wimax_state_change (struct wimax_dev * wimax_dev, enum wimax_st  
new_state);
```

## Arguments

*wimax\_dev*    WiMAX device descriptor (properly referenced)

*new\_state*    New state to switch to

## Description

This implements the state changes for the wimax devices. It will

- verify that the state transition is legal (for now it'll just print a warning if not) according to the table in `linux/wimax.h`'s documentation for 'enum wimax\_st'.
- perform the actions needed for leaving the current state and whichever are needed for entering the new state.
- issue a report to user space indicating the new state (and an optional payload with information about the new state).

## NOTE

*wimax\_dev* must be locked

## Name

`wimax_state_get` — Return the current state of a WiMAX device

## Synopsis

```
enum wimax_st wimax_state_get (struct wimax_dev * wimax_dev);
```

## Arguments

*wimax\_dev*    WiMAX device descriptor

## Returns

Current state of the device according to its driver.

## Name

`wimax_dev_init` — initialize a newly allocated instance

## Synopsis

```
void wimax_dev_init (struct wimax_dev * wimax_dev);
```

## Arguments

*wimax\_dev*    WiMAX device descriptor to initialize.

## Description

Initializes fields of a freshly allocated *wimax\_dev* instance. This function assumes that after allocation, the memory occupied by *wimax\_dev* was zeroed.

## Name

wimax\_dev\_add — Register a new WiMAX device

## Synopsis

```
int wimax_dev_add (struct wimax_dev * wimax_dev, struct net_device *  
net_dev);
```

## Arguments

*wimax\_dev*    WiMAX device descriptor (as embedded in your *net\_dev*'s priv data). You must have called `wimax_dev_init` on it before.

*net\_dev*       net device the *wimax\_dev* is associated with. The function expects `SET_NETDEV_DEV` and `register_netdev` were already called on it.

## Description

Registers the new WiMAX device, sets up the user-kernel control interface (generic netlink) and common WiMAX infrastructure.

Note that the parts that will allow interaction with user space are setup at the very end, when the rest is in place, as once that happens, the driver might get user space control requests via netlink or from debugfs that might translate into calls into `wimax_dev->op_*`.

## Name

`wimax_dev_rm` — Unregister an existing WiMAX device

## Synopsis

```
void wimax_dev_rm (struct wimax_dev * wimax_dev);
```

## Arguments

*wimax\_dev*    WiMAX device descriptor

## Description

Unregisters a WiMAX device previously registered for use with `wimax_add_rm`.

IMPORTANT! Must call before calling `unregister_netdev`.

After this function returns, you will not get any more user space control requests (via netlink or debugfs) and thus to `wimax_dev->ops`.

Reentrancy control is ensured by setting the state to `__WIMAX_ST QUIESCING`. `rkill` operations coming through `wimax_*rkill*()` will be stopped by the quiescing state; ops coming from the `rkill` subsystem will be stopped by the support being removed by `wimax_rkill_rm`.

## Name

struct wimax\_dev — Generic WiMAX device

## Synopsis

```
struct wimax_dev {
    struct net_device * net_dev;
    struct list_head id_table_node;
    struct mutex mutex;
    struct mutex mutex_reset;
    enum wimax_st state;
    int (* op_msg_from_user) (struct wimax_dev *wimax_dev, const char *, const void *,
    int (* op_rfkill_sw_toggle) (struct wimax_dev *wimax_dev, enum wimax_rf_state);
    int (* op_reset) (struct wimax_dev *wimax_dev);
    struct rfkill * rfkill;
    unsigned int rf_hw;
    unsigned int rf_sw;
    char name[32];
    struct dentry * debugfs_dentry;
};
```

## Members

net_dev	[fill] Pointer to the struct net_device this WiMAX device implements.
id_table_node	[private] link to the list of wimax devices kept by id-table.c. Protected by it's own spinlock.
mutex	[private] Serializes all concurrent access and execution of operations.
mutex_reset	[private] Serializes reset operations. Needs to be a different mutex because as part of the reset operation, the driver has to call back into the stack to do things such as state change, that require wimax_dev->mutex.
state	[private] Current state of the WiMAX device.
op_msg_from_user	[fill] Driver-specific operation to handle a raw message from user space to the driver. The driver can send messages to user space using with wimax_msg_to_user.
op_rfkill_sw_toggle	[fill] Driver-specific operation to act on userspace (or any other agent) requesting the WiMAX device to change the RF Kill software switch (WIMAX_RF_ON or WIMAX_RF_OFF). If such hardware support is not present, it is assumed the radio cannot be switched off and it is always on (and the stack will error out when trying to switch it off). In such case, this function pointer can be left as NULL.
op_reset	[fill] Driver specific operation to reset the device. This operation should always attempt first a warm reset that does not disconnect the device from the bus and return 0. If that fails, it should resort to some sort of cold or bus reset (even if it implies a bus disconnection and device disappearance). In that case, -ENODEV should be returned to indicate the device is gone. This operation has to be synchronous, and return only when the reset is

complete. In case of having had to resort to bus/cold reset implying a device disconnection, the call is allowed to return immediately.

<code>rfkill</code>	[private] integration into the RF-Kill infrastructure.
<code>rf_hw</code>	[private] State of the hardware radio switch (OFF/ON)
<code>rf_sw</code>	[private] State of the software radio switch (OFF/ON)
<code>name[32]</code>	[fill] A way to identify this device. We need to register a name with many subsystems (rfkill, workqueue creation, etc). We can't use the network device name as that might change and in some instances we don't know it yet (until we don't call <code>register_netdev</code> ). So we generate an unique one using the driver name and device bus id, place it here and use it across the board. Recommended naming: <code>DRIVERNAME-BUSNAME:BUSID</code> ( <code>dev-&gt;bus-&gt;name</code> , <code>dev-&gt;bus_id</code> ).
<code>debugfs_dentry</code>	[private] Used to hook up a debugfs entry. This shows up in the debugfs root as <code>wimax\;DEVICENAME</code> .

## NOTE

`wimax_dev->mutex` is NOT locked when this op is being called; however, `wimax_dev->mutex_reset` IS locked to ensure serialization of calls to `wimax_reset`. See `wimax_reset`'s documentation.

## Description

This structure defines a common interface to access all WiMAX devices from different vendors and provides a common API as well as a free-form device-specific messaging channel.

## Usage

1. Embed a struct `wimax_dev` at \*the beginning\* the network device structure so that `netdev_priv` points to it.
2. `memset` it to zero
3. Initialize with `wimax_dev_init`. This will leave the WiMAX device in the `__WIMAX_ST_NULL` state.
4. Fill all the fields marked with [fill]; once called `wimax_dev_add`, those fields CANNOT be modified.
5. Call `wimax_dev_add` \*after\* registering the network device. This will leave the WiMAX device in the `WIMAX_ST_DOWN` state. Protect the driver's `net_device->open` against succeeding if the wimax device state is lower than `WIMAX_ST_DOWN`.
6. Select when the device is going to be turned on/initialized; for example, it could be initialized on 'ifconfig up' (when the `netdev` op 'open' is called on the driver).

When the device is initialized (at 'ifconfig up' time, or right after calling `wimax_dev_add` from `_probe`, make sure the following steps are taken

- a. Move the device to `WIMAX_ST_UNINITIALIZED`. This is needed so some API calls that shouldn't work until the device is ready can be blocked.

b. Initialize the device. Make sure to turn the SW radio switch off and move the device to state `WIMAX_ST_RADIO_OFF` when done. When just initialized, a device should be left in RADIO OFF state until user space devices to turn it on.

c. Query the device for the state of the hardware rfkill switch and call `wimax_rfkill_report_hw` and `wimax_rfkill_report_sw` as needed. See below.

`wimax_dev_rm` undoes before unregistering the network device. Once `wimax_dev_add` is called, the driver can get called on the `wimax_dev->op_*` function pointers

## CONCURRENCY

The stack provides a mutex for each device that will disallow API calls happening concurrently; thus, `op` calls into the driver through the `wimax_dev->op*()` function pointers will always be serialized and *\*never\** concurrent.

For locking, take `wimax_dev->mutex` is taken; (most) operations in the API have to check for `wimax_dev_is_ready` to return 0 before continuing (this is done internally).

## REFERENCE COUNTING

The WiMAX device is reference counted by the associated network device. The only operation that can be used to reference the device is `wimax_dev_get_by_genl_info`, and the reference it acquires has to be released with `dev_put(wimax_dev->net_dev)`.

## RFKILL

At startup, both HW and SW radio switchess are assumed to be off.

At initialization time [after calling `wimax_dev_add`], have the driver query the device for the status of the software and hardware RF kill switches and call `wimax_report_rfkill_hw` and `wimax_rfkill_report_sw` to indicate their state. If any is missing, just call it to indicate it is ON (radio always on).

Whenever the driver detects a change in the state of the RF kill switches, it should call `wimax_report_rfkill_hw` or `wimax_report_rfkill_sw` to report it to the stack.



## Name

enum wimax\_st — The different states of a WiMAX device

## Synopsis

```
enum wimax_st {  
    __WIMAX_ST_NULL,  
    WIMAX_ST_DOWN,  
    __WIMAX_ST QUIESCING,  
    WIMAX_ST_UNINITIALIZED,  
    WIMAX_ST_RADIO_OFF,  
    WIMAX_ST_READY,  
    WIMAX_ST_SCANNING,  
    WIMAX_ST_CONNECTING,  
    WIMAX_ST_CONNECTED,  
    __WIMAX_ST_INVALID  
};
```

## Constants

__WIMAX_ST_NULL	The device structure has been allocated and zeroed, but still wimax_dev_add hasn't been called. There is no state.
WIMAX_ST_DOWN	The device has been registered with the WiMAX and networking stacks, but it is not initialized (normally that is done with 'ifconfig DEV up' [or equivalent], which can upload firmware and enable communications with the device). In this state, the device is powered down and using as less power as possible. This state is the default after a call to wimax_dev_add. It is ok to have drivers move directly to WIMAX_ST_UNINITIALIZED or WIMAX_ST_RADIO_OFF in _probe after the call to wimax_dev_add. It is recommended that the driver leaves this state when calling 'ifconfig DEV up' and enters it back on 'ifconfig DEV down'.
__WIMAX_ST QUIESCING	The device is being torn down, so no API operations are allowed to proceed except the ones needed to complete the device clean up process.
WIMAX_ST_UNINITIALIZED	[optional] Communication with the device is setup, but the device still requires some configuration before being operational. Some WiMAX API calls might work.
WIMAX_ST_RADIO_OFF	The device is fully up; radio is off (wether by hardware or software switches). It is recommended to always leave the device in this state after initialization.
WIMAX_ST_READY	The device is fully up and radio is on.
WIMAX_ST_SCANNING	[optional] The device has been instructed to scan. In this state, the device cannot be actively connected to a network.
WIMAX_ST_CONNECTING	The device is connecting to a network. This state exists because in some devices, the connect process can include a number of

negotiations between user space, kernel space and the device. User space needs to know what the device is doing. If the connect sequence in a device is atomic and fast, the device can transition directly to CONNECTED

WIMAX_ST_CONNECTED	The device is connected to a network.
__WIMAX_ST_INVALID	This is an invalid state used to mark the maximum numeric value of states.

## Description

Transitions from one state to another one are atomic and can only be caused in kernel space with `wimax_state_change`. To read the state, use `wimax_state_get`.

States starting with `__` are internal and shall not be used or referred to by drivers or userspace. They look ugly, but that's the point -- if any use is made non-internal to the stack, it is easier to catch on review.

All API operations [with well defined exceptions] will take the device mutex before starting and then check the state. If the state is `__WIMAX_ST_NULL`, `WIMAX_ST_DOWN`, `WIMAX_ST_UNINITIALIZED` or `__WIMAX_ST QUIESCING`, it will drop the lock and quit with `-EINVAL`, `-ENOMEDIUM`, `-ENOTCONN` or `-ESHUTDOWN`.

The order of the definitions is important, so we can do numerical comparisons (eg: `< WIMAX_ST_RADIO_OFF` means the device is not ready to operate).

---

# **Chapter 2. Network device support**

## **Driver Support**

## Name

`dev_add_pack` — add packet handler

## Synopsis

```
void dev_add_pack (struct packet_type * pt);
```

## Arguments

*pt* packet type declaration

## Description

Add a protocol handler to the networking stack. The passed `packet_type` is linked into kernel lists and may not be freed until it has been removed from the kernel lists.

This call does not sleep therefore it can not guarantee all CPU's that are in middle of receiving packets will see the new packet type (until the next received packet).

## Name

`__dev_remove_pack` — remove packet handler

## Synopsis

```
void __dev_remove_pack (struct packet_type * pt);
```

## Arguments

*pt* packet type declaration

## Description

Remove a protocol handler that was previously added to the kernel protocol handlers by `dev_add_pack`. The passed `packet_type` is removed from the kernel lists and can be freed or reused once this function returns.

The packet type might still be in use by receivers and must not be freed until after all the CPU's have gone through a quiescent state.

## Name

`dev_remove_pack` — remove packet handler

## Synopsis

```
void dev_remove_pack (struct packet_type * pt);
```

## Arguments

*pt* packet type declaration

## Description

Remove a protocol handler that was previously added to the kernel protocol handlers by `dev_add_pack`. The passed `packet_type` is removed from the kernel lists and can be freed or reused once this function returns.

This call sleeps to guarantee that no CPU is looking at the packet type after return.

## Name

`dev_add_offload` — register offload handlers

## Synopsis

```
void dev_add_offload (struct packet_offload * po);
```

## Arguments

*po* protocol offload declaration

## Description

Add protocol offload handlers to the networking stack. The passed `proto_offload` is linked into kernel lists and may not be freed until it has been removed from the kernel lists.

This call does not sleep therefore it can not guarantee all CPU's that are in middle of receiving packets will see the new offload handlers (until the next received packet).

## Name

`dev_remove_offload` — remove packet offload handler

## Synopsis

```
void dev_remove_offload (struct packet_offload * po);
```

## Arguments

*po* packet offload declaration

## Description

Remove a packet offload handler that was previously added to the kernel offload handlers by `dev_add_offload`. The passed `offload_type` is removed from the kernel lists and can be freed or reused once this function returns.

This call sleeps to guarantee that no CPU is looking at the packet type after return.



## Name

`netdev_boot_setup_check` — check boot time settings

## Synopsis

```
int netdev_boot_setup_check (struct net_device * dev);
```

## Arguments

*dev* the netdevice

## Description

Check boot time settings for the device. The found settings are set for the device to be used later in the device probing. Returns 0 if no settings found, 1 if they are.

## Name

`__dev_get_by_name` — find a device by its name

## Synopsis

```
struct net_device * __dev_get_by_name (struct net * net, const char  
* name);
```

## Arguments

*net*     the applicable net namespace

*name*   name to find

## Description

Find an interface by name. Must be called under RTNL semaphore or *dev\_base\_lock*. If the name is found a pointer to the device is returned. If the name is not found then `NULL` is returned. The reference counters are not incremented so the caller must be careful with locks.

## Name

`dev_get_by_name_rcu` — find a device by its name

## Synopsis

```
struct net_device * dev_get_by_name_rcu (struct net * net, const char  
* name);
```

## Arguments

*net*     the applicable net namespace

*name*   name to find

## Description

Find an interface by name. If the name is found a pointer to the device is returned. If the name is not found then `NULL` is returned. The reference counters are not incremented so the caller must be careful with locks. The caller must hold RCU lock.

## Name

`dev_get_by_name` — find a device by its name

## Synopsis

```
struct net_device * dev_get_by_name (struct net * net, const char *  
name);
```

## Arguments

*net*     the applicable net namespace

*name*   name to find

## Description

Find an interface by name. This can be called from any context and does its own locking. The returned handle has the usage count incremented and the caller must use `dev_put` to release it when it is no longer needed. `NULL` is returned if no matching device is found.

## Name

`__dev_get_by_index` — find a device by its ifindex

## Synopsis

```
struct net_device * __dev_get_by_index (struct net * net, int ifindex);
```

## Arguments

*net*            the applicable net namespace

*ifindex*    index of device

## Description

Search for an interface by index. Returns `NULL` if the device is not found or a pointer to the device. The device has not had its reference counter increased so the caller must be careful about locking. The caller must hold either the RTNL semaphore or `dev_base_lock`.

## Name

`dev_get_by_index_rcu` — find a device by its ifindex

## Synopsis

```
struct net_device * dev_get_by_index_rcu (struct net * net, int ifindex);
```

## Arguments

*net*            the applicable net namespace

*ifindex*       index of device

## Description

Search for an interface by index. Returns `NULL` if the device is not found or a pointer to the device. The device has not had its reference counter increased so the caller must be careful about locking. The caller must hold RCU lock.

## Name

`dev_get_by_index` — find a device by its ifindex

## Synopsis

```
struct net_device * dev_get_by_index (struct net * net, int ifindex);
```

## Arguments

*net*            the applicable net namespace

*ifindex*    index of device

## Description

Search for an interface by index. Returns NULL if the device is not found or a pointer to the device. The device returned has had a reference added and the pointer is safe until the user calls `dev_put` to indicate they have finished with it.

## Name

`dev_getbyhwaddr_rcu` — find a device by its hardware address

## Synopsis

```
struct net_device * dev_getbyhwaddr_rcu (struct net * net, unsigned
short type, const char * ha);
```

## Arguments

*net*     the applicable net namespace

*type*   media type of device

*ha*     hardware address

## Description

Search for an interface by MAC address. Returns NULL if the device is not found or a pointer to the device. The caller must hold RCU or RTNL. The returned device has not had its ref count increased and the caller must therefore be careful about locking



## Name

`dev_get_by_flags_rcu` — find any device with given flags

## Synopsis

```
struct net_device * dev_get_by_flags_rcu (struct net * net, unsigned
short if_flags, unsigned short mask);
```

## Arguments

<i>net</i>	the applicable net namespace
<i>if_flags</i>	IFF_* values
<i>mask</i>	bitmask of bits in <i>if_flags</i> to check

## Description

Search for any interface with the given flags. Returns NULL if a device is not found or a pointer to the device. Must be called inside `rcu_read_lock`, and result refcount is unchanged.

## Name

`dev_valid_name` — check if name is okay for network device

## Synopsis

```
bool dev_valid_name (const char * name);
```

## Arguments

*name*   name string

## Description

Network device names need to be valid file names to to allow sysfs to work. We also disallow any kind of whitespace.

## Name

`dev_alloc_name` — allocate a name for a device

## Synopsis

```
int dev_alloc_name (struct net_device * dev, const char * name);
```

## Arguments

*dev*    device

*name*   name format string

## Description

Passed a format string - eg “ltd” it will try and find a suitable id. It scans list of devices to build up a free map, then chooses the first empty slot. The caller must hold the `dev_base` or `rtnl` lock while allocating the name and adding the device in order to avoid duplicates. Limited to `bits_per_byte * page size` devices (ie 32K on most platforms). Returns the number of the unit assigned or a negative `errno` code.

## Name

`netdev_features_change` — device changes features

## Synopsis

```
void netdev_features_change (struct net_device * dev);
```

## Arguments

*dev* device to cause notification

## Description

Called to indicate a device has changed features.

## Name

`netdev_state_change` — device changes state

## Synopsis

```
void netdev_state_change (struct net_device * dev);
```

## Arguments

*dev*    device to cause notification

## Description

Called to indicate a device has changed state. This function calls the notifier chains for `netdev_chain` and sends a `NEWLINK` message to the routing socket.

## Name

`netdev_notify_peers` — notify network peers about existence of *dev*

## Synopsis

```
void netdev_notify_peers (struct net_device * dev);
```

## Arguments

*dev*    network device

## Description

Generate traffic such that interested network peers are aware of *dev*, such as by generating a gratuitous ARP. This may be used when a device wants to inform the rest of the network about some sort of reconfiguration such as a failover event or virtual machine migration.

## Name

`dev_open` — prepare an interface for use.

## Synopsis

```
int dev_open (struct net_device * dev);
```

## Arguments

*dev*    device to open

## Description

Takes a device from down to up state. The device's private open function is invoked and then the multicast lists are loaded. Finally the device is moved into the up state and a `NETDEV_UP` message is sent to the netdev notifier chain.

Calling this function on an active interface is a nop. On a failure a negative errno code is returned.

## Name

`dev_close` — shutdown an interface.

## Synopsis

```
int dev_close (struct net_device * dev);
```

## Arguments

*dev*    device to shutdown

## Description

This function moves an active device into down state. A `NETDEV_GOING_DOWN` is sent to the netdev notifier chain. The device is then deactivated and finally a `NETDEV_DOWN` is sent to the notifier chain.



## Name

`dev_disable_lro` — disable Large Receive Offload on a device

## Synopsis

```
void dev_disable_lro (struct net_device * dev);
```

## Arguments

*dev* device

## Description

Disable Large Receive Offload (LRO) on a net device. Must be called under RTNL. This is needed if received packets may be forwarded to another interface.

## Name

`register_netdevice_notifier` — register a network notifier block

## Synopsis

```
int register_netdevice_notifier (struct notifier_block * nb);
```

## Arguments

*nb* notifier

## Description

Register a notifier to be called when network device events occur. The notifier passed is linked into the kernel structures and must not be reused until it has been unregistered. A negative errno code is returned on a failure.

When registered all registration and up events are replayed to the new notifier to allow device to have a race free view of the network device list.

## Name

`unregister_netdevice_notifier` — unregister a network notifier block

## Synopsis

```
int unregister_netdevice_notifier (struct notifier_block * nb);
```

## Arguments

*nb* notifier

## Description

Unregister a notifier previously registered by `register_netdevice_notifier`. The notifier is unlinked into the kernel structures and may then be reused. A negative errno code is returned on a failure.

After unregistering unregister and down device events are synthesized for all devices on the device list to the removed notifier to remove the need for special case cleanup code.

## Name

`call_netdevice_notifiers` — call all network notifier blocks

## Synopsis

```
int call_netdevice_notifiers (unsigned long val, struct net_device *  
dev);
```

## Arguments

*val* value passed unmodified to notifier function

*dev* net\_device pointer passed unmodified to notifier function

## Description

Call all network notifier blocks. Parameters and return value are as for `raw_notifier_call_chain`.

## Name

`dev_forward_skb` — loopback an skb to another netif

## Synopsis

```
int dev_forward_skb (struct net_device * dev, struct sk_buff * skb);
```

## Arguments

*dev* destination network device

*skb* buffer to forward

## return values

NET\_RX\_SUCCESS (no congestion) NET\_RX\_DROP (packet was dropped, but freed)

`dev_forward_skb` can be used for injecting an skb from the `start_xmit` function of one device into the receive queue of another device.

The receiving device may be in another namespace, so we have to clear all information in the skb that could impact namespace isolation.

## Name

`netif_set_real_num_rx_queues` — set actual number of RX queues used

## Synopsis

```
int netif_set_real_num_rx_queues (struct net_device * dev, unsigned int
rxq);
```

## Arguments

*dev*   Network device

*rxq*   Actual number of RX queues

## Description

This must be called either with the `rtnl_lock` held or before registration of the net device. Returns 0 on success, or a negative error code. If called before registration, it always succeeds.

## Name

`netif_get_num_default_rss_queues` — default number of RSS queues

## Synopsis

```
int netif_get_num_default_rss_queues ( void );
```

## Arguments

*void* no arguments

## Description

This routine should set an upper limit on the number of RSS queues used by default by multiqueue devices.

## Name

`netif_device_detach` — mark device as removed

## Synopsis

```
void netif_device_detach (struct net_device * dev);
```

## Arguments

*dev*    network device

## Description

Mark device as removed from system and therefore no longer available.



## Name

`netif_device_attach` — mark device as attached

## Synopsis

```
void netif_device_attach (struct net_device * dev);
```

## Arguments

*dev*    network device

## Description

Mark device as attached from system and restart if needed.

## Name

`skb_mac_gso_segment` — mac layer segmentation handler.

## Synopsis

```
struct sk_buff * skb_mac_gso_segment (struct sk_buff * skb,  
netdev_features_t features);
```

## Arguments

*skb*            buffer to segment

*features*    features for the output path (see dev->features)

## Name

`__skb_gso_segment` — Perform segmentation on `skb`.

## Synopsis

```
struct sk_buff * __skb_gso_segment (struct sk_buff * skb,  
netdev_features_t features, bool tx_path);
```

## Arguments

*skb*            buffer to segment

*features*    features for the output path (see `dev->features`)

*tx\_path*      whether it is called in TX path

## Description

This function segments the given `skb` and returns a list of segments.

It may return `NULL` if the `skb` requires no segmentation. This is only possible when GSO is used for verifying header integrity.

## Name

`dev_loopback_xmit` — loop back *skb*

## Synopsis

```
int dev_loopback_xmit (struct sk_buff * skb);
```

## Arguments

*skb*    buffer to transmit

## Name

`rps_may_expire_flow` — check whether an RFS hardware filter may be removed

## Synopsis

```
bool rps_may_expire_flow (struct net_device * dev, u16 rxq_index, u32  
flow_id, u16 filter_id);
```

## Arguments

<i>dev</i>	Device on which the filter was set
<i>rxq_index</i>	RX queue index
<i>flow_id</i>	Flow ID passed to <code>ndo_rx_flow_steer</code>
<i>filter_id</i>	Filter ID returned by <code>ndo_rx_flow_steer</code>

## Description

Drivers that implement `ndo_rx_flow_steer` should periodically call this function for each installed filter and remove the filters for which it returns `true`.

## Name

`netif_rx` — post buffer to the network code

## Synopsis

```
int netif_rx (struct sk_buff * skb);
```

## Arguments

*skb*    buffer to post

## Description

This function receives a packet from a device driver and queues it for the upper (protocol) levels to process. It always succeeds. The buffer may be dropped during processing for congestion control or by the protocol layers.

## return values

`NET_RX_SUCCESS` (no congestion) `NET_RX_DROP` (packet was dropped)

## Name

`netdev_rx_handler_register` — register receive handler

## Synopsis

```
int    netdev_rx_handler_register    (struct    net_device    *    dev,  
rx_handler_func_t * rx_handler, void * rx_handler_data);
```

## Arguments

<i>dev</i>	device to register a handler for
<i>rx_handler</i>	receive handler to register
<i>rx_handler_data</i>	data pointer that is used by rx handler

## Description

Register a receive handler for a device. This handler will then be called from `__netif_receive_skb`. A negative errno code is returned on a failure.

The caller must hold the `rtnl_mutex`.

For a general description of `rx_handler`, see enum `rx_handler_result`.

## Name

`netdev_rx_handler_unregister` — unregister receive handler

## Synopsis

```
void netdev_rx_handler_unregister (struct net_device * dev);
```

## Arguments

*dev* device to unregister a handler from

## Description

Unregister a receive handler from a device.

The caller must hold the `rtnl_mutex`.



## Name

`netif_receive_skb` — process receive buffer from network

## Synopsis

```
int netif_receive_skb (struct sk_buff * skb);
```

## Arguments

*skb*    buffer to process

## Description

`netif_receive_skb` is the main receive data processing function. It always succeeds. The buffer may be dropped during processing for congestion control or by the protocol layers.

This function may only be called from softirq context and interrupts should be enabled.

Return values (usually ignored):

### NET\_RX\_SUCCESS

no congestion

### NET\_RX\_DROP

packet was dropped

## Name

`__napi_schedule` — schedule for receive

## Synopsis

```
void __napi_schedule (struct napi_struct * n);
```

## Arguments

*n* entry to schedule

## Description

The entry's receive function will be scheduled to run

## Name

`netdev_has_upper_dev` — Check if device is linked to an upper device

## Synopsis

```
bool netdev_has_upper_dev (struct net_device * dev, struct net_device  
* upper_dev);
```

## Arguments

*dev*            device

*upper\_dev*    upper device to check

## Description

Find out if a device is linked to specified upper device and return true in case it is. Note that this checks only immediate upper device, not through a complete stack of devices. The caller must hold the RTNL lock.

## Name

`netdev_master_upper_dev_get` — Get master upper device

## Synopsis

```
struct net_device * netdev_master_upper_dev_get (struct net_device *  
dev);
```

## Arguments

*dev* device

## Description

Find a master upper device and return pointer to it or NULL in case it's not there. The caller must hold the RTNL lock.

## Name

`netdev_upper_get_next_dev_rcu` — Get the next dev from upper list

## Synopsis

```
struct net_device * netdev_upper_get_next_dev_rcu (struct net_device *  
dev, struct list_head ** iter);
```

## Arguments

*dev*    device

*iter*   list\_head \*\* of the current position

## Description

Gets the next device from the dev's upper list, starting from iter position. The caller must hold RCU read lock.

## Name

`netdev_all_upper_get_next_dev_rcu` — Get the next dev from upper list

## Synopsis

```
struct net_device * netdev_all_upper_get_next_dev_rcu (struct
net_device * dev, struct list_head ** iter);
```

## Arguments

*dev* device

*iter* list\_head \*\* of the current position

## Description

Gets the next device from the dev's upper list, starting from iter position. The caller must hold RCU read lock.

## Name

`netdev_lower_get_next_private` — Get the next ->private from the lower neighbour list

## Synopsis

```
void * netdev_lower_get_next_private (struct net_device * dev, struct  
list_head ** iter);
```

## Arguments

*dev*    device

*iter*   list\_head \*\* of the current position

## Description

Gets the next `netdev_adjacent->private` from the `dev`'s lower neighbour list, starting from `iter` position. The caller must hold either hold the RTNL lock or its own locking that guarantees that the neighbour lower list will remain unchainged.

## Name

`netdev_lower_get_next_private_rcu` — Get the next `->private` from the lower neighbour list, RCU variant

## Synopsis

```
void * netdev_lower_get_next_private_rcu (struct net_device * dev,  
struct list_head ** iter);
```

## Arguments

*dev*    device

*iter*   list\_head \*\* of the current position

## Description

Gets the next `netdev_adjacent->private` from the `dev`'s lower neighbour list, starting from `iter` position. The caller must hold RCU read lock.



## Name

`netdev_lower_get_next` — Get the next device from the lower neighbour list

## Synopsis

```
void * netdev_lower_get_next (struct net_device * dev, struct list_head  
** iter);
```

## Arguments

*dev*    device

*iter*   list\_head \*\* of the current position

## Description

Gets the next `netdev_adjacent` from the `dev`'s lower neighbour list, starting from `iter` position. The caller must hold RTNL lock or its own locking that guarantees that the neighbour lower list will remain unchanged.

## Name

`netdev_lower_get_first_private_rcu` — Get the first `->private` from the lower neighbour list, RCU variant

## Synopsis

```
void * netdev_lower_get_first_private_rcu (struct net_device * dev);
```

## Arguments

*dev* device

## Description

Gets the first `netdev_adjacent->private` from the dev's lower neighbour list. The caller must hold RCU read lock.

## Name

`netdev_master_upper_dev_get_rcu` — Get master upper device

## Synopsis

```
struct net_device * netdev_master_upper_dev_get_rcu (struct net_device  
* dev);
```

## Arguments

*dev* device

## Description

Find a master upper device and return pointer to it or NULL in case it's not there. The caller must hold the RCU read lock.

## Name

`netdev_upper_dev_link` — Add a link to the upper device

## Synopsis

```
int netdev_upper_dev_link (struct net_device * dev, struct net_device  
* upper_dev);
```

## Arguments

*dev*            device

*upper\_dev*    new upper device

## Description

Adds a link to device which is upper to this one. The caller must hold the RTNL lock. On a failure a negative errno code is returned. On success the reference counts are adjusted and the function returns zero.

## Name

`netdev_master_upper_dev_link` — Add a master link to the upper device

## Synopsis

```
int netdev_master_upper_dev_link (struct net_device * dev, struct
net_device * upper_dev);
```

## Arguments

*dev*            device

*upper\_dev*    new upper device

## Description

Adds a link to device which is upper to this one. In this case, only one master upper device can be linked, although other non-master devices might be linked as well. The caller must hold the RTNL lock. On a failure a negative errno code is returned. On success the reference counts are adjusted and the function returns zero.

## Name

`netdev_upper_dev_unlink` — Removes a link to upper device

## Synopsis

```
void netdev_upper_dev_unlink (struct net_device * dev, struct net_device  
* upper_dev);
```

## Arguments

*dev*            device

*upper\_dev*    new upper device

## Description

Removes a link to device which is upper to this one. The caller must hold the RTNL lock.

## Name

`dev_set_promiscuity` — update promiscuity count on a device

## Synopsis

```
int dev_set_promiscuity (struct net_device * dev, int inc);
```

## Arguments

*dev* device

*inc* modifier

## Description

Add or remove promiscuity from a device. While the count in the device remains above zero the interface remains promiscuous. Once it hits zero the device reverts back to normal filtering operation. A negative *inc* value is used to drop promiscuity on the device. Return 0 if successful or a negative *errno* code on error.

## Name

`dev_set_allmulti` — update allmulti count on a device

## Synopsis

```
int dev_set_allmulti (struct net_device * dev, int inc);
```

## Arguments

*dev* device

*inc* modifier

## Description

Add or remove reception of all multicast frames to a device. While the count in the device remains above zero the interface remains listening to all interfaces. Once it hits zero the device reverts back to normal filtering operation. A negative *inc* value is used to drop the counter when releasing a resource needing all multicasts. Return 0 if successful or a negative errno code on error.



## Name

`dev_get_flags` — get flags reported to userspace

## Synopsis

```
unsigned int dev_get_flags (const struct net_device * dev);
```

## Arguments

*dev* device

## Description

Get the combination of flag bits exported through APIs to userspace.

## Name

`dev_change_flags` — change device settings

## Synopsis

```
int dev_change_flags (struct net_device * dev, unsigned int flags);
```

## Arguments

*dev*      device

*flags*    device state flags

## Description

Change settings on device based state flags. The flags are in the userspace exported format.

## Name

`dev_set_mtu` — Change maximum transfer unit

## Synopsis

```
int dev_set_mtu (struct net_device * dev, int new_mtu);
```

## Arguments

*dev*            device

*new\_mtu*    new transfer unit

## Description

Change the maximum transfer size of the network device.

## Name

`dev_set_group` — Change group this device belongs to

## Synopsis

```
void dev_set_group (struct net_device * dev, int new_group);
```

## Arguments

*dev*            device

*new\_group*    group this device should belong to

## Name

`dev_set_mac_address` — Change Media Access Control Address

## Synopsis

```
int dev_set_mac_address (struct net_device * dev, struct sockaddr * sa);
```

## Arguments

*dev*    device

*sa*     new address

## Description

Change the hardware (MAC) address of the device

## Name

`dev_change_carrier` — Change device carrier

## Synopsis

```
int dev_change_carrier (struct net_device * dev, bool new_carrier);
```

## Arguments

*dev*                    device

*new\_carrier*    new value

## Description

Change device carrier

## Name

`dev_get_phys_port_id` — Get device physical port ID

## Synopsis

```
int    dev_get_phys_port_id    (struct    net_device    *    dev,    struct
netdev_phys_port_id * ppid);
```

## Arguments

*dev* device

*ppid* port ID

## Description

Get device physical port ID

## Name

`netdev_update_features` — recalculate device features

## Synopsis

```
void netdev_update_features (struct net_device * dev);
```

## Arguments

*dev* the device to check

## Description

Recalculate `dev->features` set and send notifications if it has changed. Should be called after driver or hardware dependent conditions might have changed that influence the features.



## Name

`netdev_change_features` — recalculate device features

## Synopsis

```
void netdev_change_features (struct net_device * dev);
```

## Arguments

*dev* the device to check

## Description

Recalculate `dev->features` set and send notifications even if they have not changed. Should be called instead of `netdev_update_features` if also `dev->vlan_features` might have changed to allow the changes to be propagated to stacked VLAN devices.

## Name

`netif_stacked_transfer_operstate` — transfer operstate

## Synopsis

```
void netif_stacked_transfer_operstate (const struct net_device *  
rootdev, struct net_device * dev);
```

## Arguments

*rootdev*    the root or lower level device to transfer state from

*dev*        the device to transfer operstate to

## Description

Transfer operational state from root to device. This is normally called when a stacking relationship exists between the root device and the device(a leaf device).

## Name

`register_netdevice` — register a network device

## Synopsis

```
int register_netdevice (struct net_device * dev);
```

## Arguments

*dev*    device to register

## Description

Take a completed network device structure and add it to the kernel interfaces. A `NETDEV_REGISTER` message is sent to the netdev notifier chain. 0 is returned on success. A negative errno code is returned on a failure to set up the device, or if the name is a duplicate.

Callers must hold the rtnl semaphore. You may want `register_netdev` instead of this.

## BUGS

The locking appears insufficient to guarantee two parallel registers will not get the same name.

## Name

`init_dummy_netdev` — init a dummy network device for NAPI

## Synopsis

```
int init_dummy_netdev (struct net_device * dev);
```

## Arguments

*dev*    device to init

## Description

This takes a network device structure and initialize the minimum amount of fields so it can be used to schedule NAPI polls without registering a full blown interface. This is to be used by drivers that need to tie several hardware interfaces to a single NAPI poll scheduler due to HW limitations.

## Name

`register_netdev` — register a network device

## Synopsis

```
int register_netdev (struct net_device * dev);
```

## Arguments

*dev*    device to register

## Description

Take a completed network device structure and add it to the kernel interfaces. A `NETDEV_REGISTER` message is sent to the netdev notifier chain. 0 is returned on success. A negative errno code is returned on a failure to set up the device, or if the name is a duplicate.

This is a wrapper around `register_netdevice` that takes the `rtnl` semaphore and expands the device name if you passed a format string to `alloc_netdev`.

## Name

`dev_get_stats` — get network device statistics

## Synopsis

```
struct rtnl_link_stats64 * dev_get_stats (struct net_device * dev,  
struct rtnl_link_stats64 * storage);
```

## Arguments

*dev*            device to get statistics from

*storage*       place to store stats

## Description

Get network statistics from device. Return *storage*. The device driver may provide its own method by setting `dev->netdev_ops->get_stats64` or `dev->netdev_ops->get_stats`; otherwise the internal statistics structure is used.

## Name

`alloc_netdev_mqs` — allocate network device

## Synopsis

```
struct net_device * alloc_netdev_mqs (int sizeof_priv, const char *  
name, void (*setup) (struct net_device *), unsigned int txqs, unsigned  
int rxqs);
```

## Arguments

*sizeof\_priv*    size of private data to allocate space for

*name*            device name format string

*setup*           callback to initialize device

*txqs*            the number of TX subqueues to allocate

*rxqs*            the number of RX subqueues to allocate

## Description

Allocates a struct `net_device` with private data area for driver use and performs basic initialization. Also allocates subqueue structs for each queue on the device.

## Name

`free_netdev` — free network device

## Synopsis

```
void free_netdev (struct net_device * dev);
```

## Arguments

*dev* device

## Description

This function does the last stage of destroying an allocated device interface. The reference to the device object is released. If this is the last reference then it will be freed.



## Name

synchronize\_net — Synchronize with packet receive processing

## Synopsis

```
void synchronize_net ( void );
```

## Arguments

*void* no arguments

## Description

Wait for packets currently being received to be done. Does not block later packets from starting.

## Name

`unregister_netdevice_queue` — remove device from the kernel

## Synopsis

```
void unregister_netdevice_queue (struct net_device * dev, struct  
list_head * head);
```

## Arguments

*dev* device

*head* list

## Description

This function shuts down a device interface and removes it from the kernel tables. If *head* not NULL, device is queued to be unregistered later.

Callers must hold the `rtnl` semaphore. You may want `unregister_netdev` instead of this.

## Name

`unregister_netdevice_many` — unregister many devices

## Synopsis

```
void unregister_netdevice_many (struct list_head * head);
```

## Arguments

*head* list of devices

## Note

As most callers use a stack allocated `list_head`, we force a `list_del` to make sure stack wont be corrupted later.

## Name

`unregister_netdev` — remove device from the kernel

## Synopsis

```
void unregister_netdev (struct net_device * dev);
```

## Arguments

*dev* device

## Description

This function shuts down a device interface and removes it from the kernel tables.

This is just a wrapper for `unregister_netdevice` that takes the `rtnl` semaphore. In general you want to use this and not `unregister_netdevice`.

## Name

`dev_change_net_namespace` — move device to different nethost namespace

## Synopsis

```
int dev_change_net_namespace (struct net_device * dev, struct net * net,  
const char * pat);
```

## Arguments

*dev* device

*net* network namespace

*pat* If not NULL name pattern to try if the current device name is already taken in the destination network namespace.

## Description

This function shuts down a device interface and moves it to a new network namespace. On success 0 is returned, on a failure a netagive errno code is returned.

Callers must hold the rtnl semaphore.

## Name

`netdev_increment_features` — increment feature set by one

## Synopsis

```
netdev_features_t netdev_increment_features (netdev_features_t all,  
netdev_features_t one, netdev_features_t mask);
```

## Arguments

*all*     current feature set

*one*     new feature set

*mask*    mask feature set

## Description

Computes a new feature set after adding a device with feature set *one* to the master device with current feature set *all*. Will not enable anything that is off in *mask*. Returns the new feature set.

## Name

`eth_header` — create the Ethernet header

## Synopsis

```
int eth_header (struct sk_buff * skb, struct net_device * dev, unsigned
short type, const void * daddr, const void * saddr, unsigned int len);
```

## Arguments

<i>skb</i>	buffer to alter
<i>dev</i>	source device
<i>type</i>	Ethernet type field
<i>daddr</i>	destination address (NULL leave destination address)
<i>saddr</i>	source address (NULL use device source address)
<i>len</i>	packet length (<= <code>skb-&gt;len</code> )

## Description

Set the protocol type. For a packet of type `ETH_P_802_3/2` we put the length in here instead.

## Name

`eth_rebuild_header` — rebuild the Ethernet MAC header.

## Synopsis

```
int eth_rebuild_header (struct sk_buff * skb);
```

## Arguments

*skb*    socket buffer to update

## Description

This is called after an ARP or IPV6 ndisc it's resolution on this `sk_buff`. We now let protocol (ARP) fill in the other fields.

This routine CANNOT use cached `dst->neigh`! Really, it is used only when `dst->neigh` is wrong.



## Name

`eth_type_trans` — determine the packet's protocol ID.

## Synopsis

```
__be16 eth_type_trans (struct sk_buff * skb, struct net_device * dev);
```

## Arguments

*skb* received socket data

*dev* receiving network device

## Description

The rule here is that we assume 802.3 if the type field is short enough to be a length. This is normal practice and works for any 'now in use' protocol.

## Name

`eth_header_parse` — extract hardware address from packet

## Synopsis

```
int eth_header_parse (const struct sk_buff * skb, unsigned char * haddr);
```

## Arguments

*skb*      packet to extract header from

*haddr*   destination buffer

## Name

`eth_header_cache` — fill cache entry from neighbour

## Synopsis

```
int eth_header_cache (const struct neighbour * neigh, struct hh_cache  
* hh, __be16 type);
```

## Arguments

*neigh*    source neighbour

*hh*       destination cache entry

*type*    Ethernet type field

## Description

Create an Ethernet header template from the neighbour.

## Name

`eth_header_cache_update` — update cache entry

## Synopsis

```
void eth_header_cache_update (struct hh_cache * hh, const struct  
net_device * dev, const unsigned char * haddr);
```

## Arguments

*hh* destination cache entry

*dev* network device

*haddr* new hardware address

## Description

Called by Address Resolution module to notify changes in address.

## Name

`eth_prepare_mac_addr_change` — prepare for mac change

## Synopsis

```
int eth_prepare_mac_addr_change (struct net_device * dev, void * p);
```

## Arguments

*dev*    network device

*p*      socket address

## Name

`eth_commit_mac_addr_change` — commit mac change

## Synopsis

```
void eth_commit_mac_addr_change (struct net_device * dev, void * p);
```

## Arguments

*dev*    network device

*p*      socket address

## Name

`eth_mac_addr` — set new Ethernet hardware address

## Synopsis

```
int eth_mac_addr (struct net_device * dev, void * p);
```

## Arguments

*dev*    network device

*p*      socket address

## Description

Change hardware address of device.

This doesn't change hardware matching, so needs to be overridden for most real devices.

## Name

`eth_change_mtu` — set new MTU size

## Synopsis

```
int eth_change_mtu (struct net_device * dev, int new_mtu);
```

## Arguments

*dev*            network device

*new\_mtu*    new Maximum Transfer Unit

## Description

Allow changing MTU size. Needs to be overridden for devices supporting jumbo frames.



## Name

`ether_setup` — setup Ethernet network device

## Synopsis

```
void ether_setup (struct net_device * dev);
```

## Arguments

*dev*    network device

## Description

Fill in the fields of the device structure with Ethernet-generic values.

## Name

`alloc_etherdev_mqs` — Allocates and sets up an Ethernet device

## Synopsis

```
struct net_device * alloc_etherdev_mqs (int sizeof_priv, unsigned int
txqs, unsigned int rxqs);
```

## Arguments

*sizeof\_priv*    Size of additional driver-private structure to be allocated for this Ethernet device

*txqs*            The number of TX queues this device has.

*rxqs*            The number of RX queues this device has.

## Description

Fill in the fields of the device structure with Ethernet-generic values. Basically does everything except registering the device.

Constructs a new net device, complete with a private data area of size (*sizeof\_priv*). A 32-byte (not bit) alignment is enforced for this private data area.

## Name

`netif_carrier_on` — set carrier

## Synopsis

```
void netif_carrier_on (struct net_device * dev);
```

## Arguments

*dev*    network device

## Description

Device has detected that carrier.

## Name

`netif_carrier_off` — clear carrier

## Synopsis

```
void netif_carrier_off (struct net_device * dev);
```

## Arguments

*dev*    network device

## Description

Device has detected loss of carrier.

## Name

`is_link_local_ether_addr` — Determine if given Ethernet address is link-local

## Synopsis

```
bool is_link_local_ether_addr (const u8 * addr);
```

## Arguments

*addr* Pointer to a six-byte array containing the Ethernet address

## Description

Return true if address is link local reserved addr (01:80:c2:00:00:0X) per IEEE 802.1Q 8.6.3 Frame filtering.

## Please note

*addr* must be aligned to u16.

## Name

`is_zero_ether_addr` — Determine if give Ethernet address is all zeros.

## Synopsis

```
bool is_zero_ether_addr (const u8 * addr);
```

## Arguments

*addr* Pointer to a six-byte array containing the Ethernet address

## Description

Return true if the address is all zeroes.

## Please note

`addr` must be aligned to u16.

## Name

`is_multicast_ether_addr` — Determine if the Ethernet address is a multicast.

## Synopsis

```
bool is_multicast_ether_addr (const u8 * addr);
```

## Arguments

*addr* Pointer to a six-byte array containing the Ethernet address

## Description

Return true if the address is a multicast address. By definition the broadcast address is also a multicast address.

## Name

`is_local_ether_addr` — Determine if the Ethernet address is locally-assigned one (IEEE 802).

## Synopsis

```
bool is_local_ether_addr (const u8 * addr);
```

## Arguments

*addr* Pointer to a six-byte array containing the Ethernet address

## Description

Return true if the address is a local address.



## Name

`is_broadcast_ether_addr` — Determine if the Ethernet address is broadcast

## Synopsis

```
bool is_broadcast_ether_addr (const u8 * addr);
```

## Arguments

*addr* Pointer to a six-byte array containing the Ethernet address

## Description

Return true if the address is the broadcast address.

## Please note

*addr* must be aligned to u16.

## Name

`is_unicast_ether_addr` — Determine if the Ethernet address is unicast

## Synopsis

```
bool is_unicast_ether_addr (const u8 * addr);
```

## Arguments

*addr* Pointer to a six-byte array containing the Ethernet address

## Description

Return true if the address is a unicast address.

## Name

`is_valid_ether_addr` — Determine if the given Ethernet address is valid

## Synopsis

```
bool is_valid_ether_addr (const u8 * addr);
```

## Arguments

*addr* Pointer to a six-byte array containing the Ethernet address

## Description

Check that the Ethernet address (MAC) is not 00:00:00:00:00:00, is not a multicast address, and is not FF:FF:FF:FF:FF:FF.

Return true if the address is valid.

## Please note

`addr` must be aligned to `u16`.

## Name

`eth_random_addr` — Generate software assigned random Ethernet address

## Synopsis

```
void eth_random_addr (u8 * addr);
```

## Arguments

*addr* Pointer to a six-byte array containing the Ethernet address

## Description

Generate a random Ethernet address (MAC) that is not multicast and has the local assigned bit set.

## Name

`eth_broadcast_addr` — Assign broadcast address

## Synopsis

```
void eth_broadcast_addr (u8 * addr);
```

## Arguments

*addr* Pointer to a six-byte array containing the Ethernet address

## Description

Assign the broadcast address to the given address array.

## Name

`eth_zero_addr` — Assign zero address

## Synopsis

```
void eth_zero_addr (u8 * addr);
```

## Arguments

*addr* Pointer to a six-byte array containing the Ethernet address

## Description

Assign the zero address to the given address array.

## Name

`eth_hw_addr_random` — Generate software assigned random Ethernet and set device flag

## Synopsis

```
void eth_hw_addr_random (struct net_device * dev);
```

## Arguments

*dev* pointer to `net_device` structure

## Description

Generate a random Ethernet address (MAC) to be used by a net device and set `addr_assign_type` so the state can be read by `sysfs` and be used by userspace.

## Name

`ether_addr_copy` — Copy an Ethernet address

## Synopsis

```
void ether_addr_copy (u8 * dst, const u8 * src);
```

## Arguments

*dst*    Pointer to a six-byte array Ethernet address destination

*src*    Pointer to a six-byte array Ethernet address source

## Please note

*dst* & *src* must both be aligned to u16.



## Name

`eth_hw_addr_inherit` — Copy dev\_addr from another net\_device

## Synopsis

```
void eth_hw_addr_inherit (struct net_device * dst, struct net_device  
* src);
```

## Arguments

*dst* pointer to net\_device to copy dev\_addr to

*src* pointer to net\_device to copy dev\_addr from

## Description

Copy the Ethernet address from one net\_device to another along with the address attributes (addr\_assign\_type).

## Name

`ether_addr_equal` — Compare two Ethernet addresses

## Synopsis

```
bool ether_addr_equal (const u8 * addr1, const u8 * addr2);
```

## Arguments

*addr1* Pointer to a six-byte array containing the Ethernet address

*addr2* Pointer other six-byte array containing the Ethernet address

## Description

Compare two Ethernet addresses, returns true if equal

## Please note

`addr1` & `addr2` must both be aligned to u16.

## Name

`ether_addr_equal_64bits` — Compare two Ethernet addresses

## Synopsis

```
bool ether_addr_equal_64bits (const u8 addr1[6+2], const u8 addr2[6+2]);
```

## Arguments

*addr1*[6+2]    Pointer to an array of 8 bytes

*addr2*[6+2]    Pointer to an other array of 8 bytes

## Description

Compare two Ethernet addresses, returns true if equal, false otherwise.

The function doesn't need any conditional branches and possibly uses word memory accesses on CPU allowing cheap unaligned memory reads. arrays = { byte1, byte2, byte3, byte4, byte5, byte6, pad1, pad2 }

Please note that alignment of *addr1* & *addr2* are only guaranteed to be 16 bits.

## Name

`ether_addr_equal_unaligned` — Compare two not u16 aligned Ethernet addresses

## Synopsis

```
bool ether_addr_equal_unaligned (const u8 * addr1, const u8 * addr2);
```

## Arguments

*addr1* Pointer to a six-byte array containing the Ethernet address

*addr2* Pointer other six-byte array containing the Ethernet address

## Description

Compare two Ethernet addresses, returns true if equal

## Please note

Use only when any Ethernet address may not be u16 aligned.

## Name

`is_etherdev_addr` — Tell if given Ethernet address belongs to the device.

## Synopsis

```
bool is_etherdev_addr (const struct net_device * dev, const u8 addr[6 + 2]);
```

## Arguments

*dev*                      Pointer to a device structure

*addr*[6 + 2]      Pointer to a six-byte array containing the Ethernet address

## Description

Compare passed address with all addresses of the device. Return true if the address if one of the device addresses.

Note that this function calls `ether_addr_equal_64bits` so take care of the right padding.

## Name

`compare_ether_header` — Compare two Ethernet headers

## Synopsis

```
unsigned long compare_ether_header (const void * a, const void * b);
```

## Arguments

*a* Pointer to Ethernet header

*b* Pointer to Ethernet header

## Description

Compare two Ethernet headers, returns 0 if equal. This assumes that the network header (i.e., IP header) is 4-byte aligned OR the platform can handle unaligned access. This is the case for all packets coming into `netif_receive_skb` or similar entry points.

## Name

`napi_schedule_prep` — check if napi can be scheduled

## Synopsis

```
bool napi_schedule_prep (struct napi_struct * n);
```

## Arguments

*n* napi context

## Description

Test if NAPI routine is already running, and if not mark it as running. This is used as a condition variable insure only one NAPI poll instance runs. We also make sure there is no pending NAPI disable.

## Name

napi\_schedule — schedule NAPI poll

## Synopsis

```
void napi_schedule (struct napi_struct * n);
```

## Arguments

*n* napi context

## Description

Schedule NAPI poll routine to be called if it is not already running.



## Name

`napi_disable` — prevent NAPI from scheduling

## Synopsis

```
void napi_disable (struct napi_struct * n);
```

## Arguments

*n* napi context

## Description

Stop NAPI from being scheduled on this context. Waits till any outstanding processing completes.

## Name

`napi_enable` — enable NAPI scheduling

## Synopsis

```
void napi_enable (struct napi_struct * n);
```

## Arguments

*n* napi context

## Description

Resume NAPI from being scheduled on this context. Must be paired with `napi_disable`.

## Name

`napi_synchronize` — wait until NAPI is not running

## Synopsis

```
void napi_synchronize (const struct napi_struct * n);
```

## Arguments

*n* napi context

## Description

Wait until NAPI is done being scheduled on this context. Waits till any outstanding processing completes but does not disable future activations.

## Name

enum netdev\_priv\_flags — struct net\_device priv\_flags

## Synopsis

```
enum netdev_priv_flags {
    IFF_802_1Q_VLAN,
    IFF_EBRIDGE,
    IFF_SLAVE_INACTIVE,
    IFF_MASTER_8023AD,
    IFF_MASTER_ALB,
    IFF_BONDING,
    IFF_SLAVE_NEEDARP,
    IFF_ISATAP,
    IFF_MASTER_ARPMON,
    IFF_WAN_HDLC,
    IFF_XMIT_DST_RELEASE,
    IFF_DONT_BRIDGE,
    IFF_DISABLE_NETPOLL,
    IFF_MACVLAN_PORT,
    IFF_BRIDGE_PORT,
    IFF_OVS_DATAPATH,
    IFF_TX_SKB_SHARING,
    IFF_UNICAST_FLT,
    IFF_TEAM_PORT,
    IFF_SUPP_NOFCS,
    IFF_LIVE_ADDR_CHANGE,
    IFF_MACVLAN
};
```

## Constants

IFF_802_1Q_VLAN	802.1Q VLAN device
IFF_EBRIDGE	Ethernet bridging device
IFF_SLAVE_INACTIVE	bonding slave not the curr. active
IFF_MASTER_8023AD	bonding master, 802.3ad
IFF_MASTER_ALB	bonding master, balance-alb
IFF_BONDING	bonding master or slave
IFF_SLAVE_NEEDARP	need ARPs for validation
IFF_ISATAP	ISATAP interface (RFC4214)
IFF_MASTER_ARPMON	bonding master, ARP mon in use
IFF_WAN_HDLC	WAN HDLC device
IFF_XMIT_DST_RELEASE	dev_hard_start_xmit is allowed to release skb->dst

IFF_DONT_BRIDGE	disallow bridging this ether dev
IFF_DISABLE_NETPOLL	disable netpoll at run-time
IFF_MACVLAN_PORT	device used as macvlan port
IFF_BRIDGE_PORT	device used as bridge port
IFF_OVS_DATAPATH	device used as Open vSwitch datapath port
IFF_TX_SKB_SHARING	The interface supports sharing skbs on transmit
IFF_UNICAST_FLT	Supports unicast filtering
IFF_TEAM_PORT	device used as team port
IFF_SUPP_NOFCS	device supports sending custom FCS
IFF_LIVE_ADDR_CHANGE	device supports hardware address change when it's running
IFF_MACVLAN	Macvlan device

## Description

These are the struct `net_device`, they are only set internally by drivers and used in the kernel. These flags are invisible to userspace, this means that the order of these flags can change during any kernel release.

You should have a pretty good reason to be extending these flags.

## Name

`netdev_priv` — access network device private data

## Synopsis

```
void * netdev_priv (const struct net_device * dev);
```

## Arguments

*dev*    network device

## Description

Get network device private data

## Name

`netif_start_queue` — allow transmit

## Synopsis

```
void netif_start_queue (struct net_device * dev);
```

## Arguments

*dev*    network device

## Description

Allow upper layers to call the device `hard_start_xmit` routine.

## Name

`netif_wake_queue` — restart transmit

## Synopsis

```
void netif_wake_queue (struct net_device * dev);
```

## Arguments

*dev*   network device

## Description

Allow upper layers to call the device `hard_start_xmit` routine. Used for flow control when transmit resources are available.



## Name

`netif_stop_queue` — stop transmitted packets

## Synopsis

```
void netif_stop_queue (struct net_device * dev);
```

## Arguments

*dev*    network device

## Description

Stop upper layers calling the device `hard_start_xmit` routine. Used for flow control when transmit resources are unavailable.

## Name

`netif_queue_stopped` — test if transmit queue is flowblocked

## Synopsis

```
bool netif_queue_stopped (const struct net_device * dev);
```

## Arguments

*dev*   network device

## Description

Test if transmit queue on device is currently unable to send.

## Name

`netdev_sent_queue` — report the number of bytes queued to hardware

## Synopsis

```
void netdev_sent_queue (struct net_device * dev, unsigned int bytes);
```

## Arguments

*dev*      network device

*bytes*    number of bytes queued to the hardware device queue

## Description

Report the number of bytes queued for sending/completion to the network device hardware queue. *bytes* should be a good approximation and should exactly match `netdev_completed_queue` *bytes*

## Name

`netdev_completed_queue` — report bytes and packets completed by device

## Synopsis

```
void netdev_completed_queue (struct net_device * dev, unsigned int pkts,  
unsigned int bytes);
```

## Arguments

*dev*      network device

*pkts*     actual number of packets sent over the medium

*bytes*    actual number of bytes sent over the medium

## Description

Report the number of bytes and packets transmitted by the network device hardware queue over the physical medium, *bytes* must exactly match the *bytes* amount passed to `netdev_sent_queue`

## Name

`netdev_reset_queue` — reset the packets and bytes count of a network device

## Synopsis

```
void netdev_reset_queue (struct net_device * dev_queue);
```

## Arguments

*dev\_queue*    network device

## Description

Reset the bytes and packet count of a network device and clear the software flow control OFF bit for this network device

## Name

`netdev_cap_txqueue` — check if selected tx queue exceeds device queues

## Synopsis

```
u16 netdev_cap_txqueue (struct net_device * dev, u16 queue_index);
```

## Arguments

*dev*                      network device

*queue\_index*    given tx queue index

## Description

Returns 0 if given tx queue index  $\geq$  number of device tx queues, otherwise returns the originally passed tx queue index.

## Name

`netif_running` — test if up

## Synopsis

```
bool netif_running (const struct net_device * dev);
```

## Arguments

*dev*    network device

## Description

Test if the device has been brought up.

## Name

`netif_start_subqueue` — allow sending packets on subqueue

## Synopsis

```
void netif_start_subqueue (struct net_device * dev, u16 queue_index);
```

## Arguments

*dev*                      network device

*queue\_index*    sub queue index

## Description

Start individual transmit queue of a device with multiple transmit queues.



## Name

`netif_stop_subqueue` — stop sending packets on subqueue

## Synopsis

```
void netif_stop_subqueue (struct net_device * dev, u16 queue_index);
```

## Arguments

*dev*                    network device

*queue\_index*    sub queue index

## Description

Stop individual transmit queue of a device with multiple transmit queues.

## Name

`__netif_subqueue_stopped` — test status of subqueue

## Synopsis

```
bool __netif_subqueue_stopped (const struct net_device * dev, u16
queue_index);
```

## Arguments

*dev*                    network device

*queue\_index*    sub queue index

## Description

Check individual transmit queue of a device with multiple transmit queues.

## Name

`netif_wake_subqueue` — allow sending packets on subqueue

## Synopsis

```
void netif_wake_subqueue (struct net_device * dev, u16 queue_index);
```

## Arguments

*dev*                      network device

*queue\_index*    sub queue index

## Description

Resume individual transmit queue of a device with multiple transmit queues.

## Name

`netif_is_multiqueue` — test if device has multiple transmit queues

## Synopsis

```
bool netif_is_multiqueue (const struct net_device * dev);
```

## Arguments

*dev*    network device

## Description

Check if device has multiple transmit queues

## Name

`dev_put` — release reference to device

## Synopsis

```
void dev_put (struct net_device * dev);
```

## Arguments

*dev*    network device

## Description

Release reference to device to allow it to be freed.

## Name

`dev_hold` — get reference to device

## Synopsis

```
void dev_hold (struct net_device * dev);
```

## Arguments

*dev*    network device

## Description

Hold reference to device to keep it from being freed.

## Name

`netif_carrier_ok` — test if carrier present

## Synopsis

```
bool netif_carrier_ok (const struct net_device * dev);
```

## Arguments

*dev*   network device

## Description

Check if carrier is present on device

## Name

`netif_dormant_on` — mark device as dormant.

## Synopsis

```
void netif_dormant_on (struct net_device * dev);
```

## Arguments

*dev*    network device

## Description

Mark device as dormant (as per RFC2863).

The dormant state indicates that the relevant interface is not actually in a condition to pass packets (i.e., it is not 'up') but is in a “pending” state, waiting for some external event. For “on- demand” interfaces, this new state identifies the situation where the interface is waiting for events to place it in the up state.



## Name

`netif_dormant_off` — set device as not dormant.

## Synopsis

```
void netif_dormant_off (struct net_device * dev);
```

## Arguments

*dev*   network device

## Description

Device is not in dormant state.

## Name

`netif_dormant` — test if carrier present

## Synopsis

```
bool netif_dormant (const struct net_device * dev);
```

## Arguments

*dev*    network device

## Description

Check if carrier is present on device

## Name

`netif_oper_up` — test if device is operational

## Synopsis

```
bool netif_oper_up (const struct net_device * dev);
```

## Arguments

*dev*    network device

## Description

Check if carrier is operational

## Name

`netif_device_present` — is device available or removed

## Synopsis

```
bool netif_device_present (struct net_device * dev);
```

## Arguments

*dev*    network device

## Description

Check if device has not been removed from system.

## Name

`netif_tx_lock` — grab network device transmit lock

## Synopsis

```
void netif_tx_lock (struct net_device * dev);
```

## Arguments

*dev*    network device

## Description

Get network device transmit lock

## Name

`__dev_uc_sync` — Synchronize device's unicast list

## Synopsis

```
int __dev_uc_sync (struct net_device * dev, int (*sync) (struct
net_device *, const unsigned char *), int (*unsync) (struct net_device
*, const unsigned char *));
```

## Arguments

*dev*        device to sync

*sync*       function to call if address should be added

*unsync*    function to call if address should be removed

## Description

Add newly added addresses to the interface, and release addresses that have been deleted.

## Name

`__dev_uc_unsync` — Remove synchronized addresses from device

## Synopsis

```
void __dev_uc_unsync (struct net_device * dev, int (*unsync) (struct
net_device *, const unsigned char *));
```

## Arguments

*dev*        device to sync

*unsync*    function to call if address should be removed

## Description

Remove all addresses that were added to the device by `dev_uc_sync`.

## Name

`__dev_mc_sync` — Synchronize device's multicast list

## Synopsis

```
int __dev_mc_sync (struct net_device * dev, int (*sync) (struct
net_device *, const unsigned char *), int (*unsync) (struct net_device
*, const unsigned char *));
```

## Arguments

*dev*        device to sync

*sync*       function to call if address should be added

*unsync*    function to call if address should be removed

## Description

Add newly added addresses to the interface, and release addresses that have been deleted.



## Name

`__dev_mc_unsync` — Remove synchronized addresses from device

## Synopsis

```
void __dev_mc_unsync (struct net_device * dev, int (*unsync) (struct
net_device *, const unsigned char *));
```

## Arguments

*dev*        device to sync

*unsync*    function to call if address should be removed

## Description

Remove all addresses that were added to the device by `dev_mc_sync`.

## PHY Support

## Name

`phy_print_status` — Convenience function to print out the current phy status

## Synopsis

```
void phy_print_status (struct phy_device * phydev);
```

## Arguments

*phydev* the `phy_device` struct

## Name

`phy_ethtool_sset` — generic ethtool sset function, handles all the details

## Synopsis

```
int phy_ethtool_sset (struct phy_device * phydev, struct ethtool_cmd  
* cmd);
```

## Arguments

*phydev*    target `phy_device` struct

*cmd*        `ethtool_cmd`

## A few notes about parameter checking

- We don't set port or transceiver, so we don't care what they were set to. - `phy_start_aneg` will make sure forced settings are sane, and choose the next best ones from the ones selected, so we don't care if ethtool tries to give us bad values.

## Name

`phy_mii_ioctl` — generic PHY MII ioctl interface

## Synopsis

```
int phy_mii_ioctl (struct phy_device * phydev, struct ifreq * ifr, int
cmd);
```

## Arguments

*phydev*    the `phy_device` struct

*ifr*       struct `ifreq` for socket ioctl's

*cmd*       ioctl cmd to execute

## Description

Note that this function is currently incompatible with the PHYCONTROL layer. It changes registers without regard to current state. Use at own risk.

## Name

`phy_start_aneg` — start auto-negotiation for this PHY device

## Synopsis

```
int phy_start_aneg (struct phy_device * phydev);
```

## Arguments

*phydev* the `phy_device` struct

## Description

Sanitizes the settings (if we're not autonegotiating them), and then calls the driver's `config_aneg` function. If the PHYCONTROL Layer is operating, we change the state to reflect the beginning of Auto-negotiation or forcing.

## Name

`phy_start_interrupts` — request and enable interrupts for a PHY device

## Synopsis

```
int phy_start_interrupts (struct phy_device * phydev);
```

## Arguments

*phydev*    target `phy_device` struct

## Description

Request the interrupt for the given PHY. If this fails, then we set `irq` to `PHY_POLL`. Otherwise, we enable the interrupts in the PHY. This should only be called with a valid IRQ number. Returns 0 on success or  $< 0$  on error.

## Name

`phy_stop_interrupts` — disable interrupts from a PHY device

## Synopsis

```
int phy_stop_interrupts (struct phy_device * phydev);
```

## Arguments

*phydev*    target `phy_device` struct

## Name

`phy_stop` — Bring down the PHY link, and stop checking the status

## Synopsis

```
void phy_stop (struct phy_device * phydev);
```

## Arguments

*phydev*   target `phy_device` struct



## Name

`phy_start` — start or restart a PHY device

## Synopsis

```
void phy_start (struct phy_device * phydev);
```

## Arguments

*phydev*   target `phy_device` struct

## Description

Indicates the attached device's readiness to handle PHY-related work. Used during startup to start the PHY, and after a call to `phy_stop` to resume operation. Also used to indicate the MDIO bus has cleared an error condition.

## Name

`phy_init_eee` — init and check the EEE feature

## Synopsis

```
int phy_init_eee (struct phy_device * phydev, bool clk_stop_enable);
```

## Arguments

*phydev*                      target `phy_device` struct

*clk\_stop\_enable*    PHY may stop the clock during LPI

## Description

it checks if the Energy-Efficient Ethernet (EEE) is supported by looking at the MMD registers 3.20 and 7.60/61 and it programs the MMD register 3.0 setting the “Clock stop enable” bit if required.

## Name

`phy_get_eee_err` — report the EEE wake error count

## Synopsis

```
int phy_get_eee_err (struct phy_device * phydev);
```

## Arguments

*phydev*    target `phy_device` struct

## Description

it is to report the number of time where the PHY failed to complete its normal wake sequence.

## Name

`phy_ethtool_get_eee` — get EEE supported and status

## Synopsis

```
int phy_ethtool_get_eee (struct phy_device * phydev, struct ethtool_eee  
* data);
```

## Arguments

*phydev*    target phy\_device struct

*data*      ethtool\_eee data

## Description

it reportes the Supported/Advertisement/LP Advertisement capabilities.

## Name

`phy_ethtool_set_eee` — set EEE supported and status

## Synopsis

```
int phy_ethtool_set_eee (struct phy_device * phydev, struct ethtool_eee  
* data);
```

## Arguments

*phydev*    target `phy_device` struct

*data*      `ethtool_eee` data

## Description

it is to program the Advertisement EEE register.

## Name

`phy_clear_interrupt` — Ack the phy device's interrupt

## Synopsis

```
int phy_clear_interrupt (struct phy_device * phydev);
```

## Arguments

*phydev* the `phy_device` struct

## Description

If the *phydev* driver has an `ack_interrupt` function, call it to ack and clear the phy device's interrupt.

Returns 0 on success or < 0 on error.

## Name

`phy_config_interrupt` — configure the PHY device for the requested interrupts

## Synopsis

```
int phy_config_interrupt (struct phy_device * phydev, u32 interrupts);
```

## Arguments

*phydev*            the `phy_device` struct

*interrupts*    interrupt flags to configure for this *phydev*

## Description

Returns 0 on success or < 0 on error.

## Name

`phy_aneg_done` — return auto-negotiation status

## Synopsis

```
int phy_aneg_done (struct phy_device * phydev);
```

## Arguments

*phydev*    target `phy_device` struct

## Description

Return the auto-negotiation status from this *phydev*. Returns  $> 0$  on success or  $< 0$  on error. 0 means that auto-negotiation is still pending.



## Name

`phy_find_setting` — find a PHY settings array entry that matches speed & duplex

## Synopsis

```
unsigned int phy_find_setting (int speed, int duplex);
```

## Arguments

*speed*    speed to match

*duplex*   duplex to match

## Description

Searches the settings array for the setting which matches the desired speed and duplex, and returns the index of that setting. Returns the index of the last setting if none of the others match.

## Name

`phy_find_valid` — find a PHY setting that matches the requested features mask

## Synopsis

```
unsigned int phy_find_valid (unsigned int idx, u32 features);
```

## Arguments

*idx*            The first index in `settings[]` to search

*features*      A mask of the valid settings

## Description

Returns the index of the first valid setting less than or equal to the one pointed to by `idx`, as determined by the mask in `features`. Returns the index of the last setting if nothing else matches.

## Name

`phy_sanitize_settings` — make sure the PHY is set to supported speed and duplex

## Synopsis

```
void phy_sanitize_settings (struct phy_device * phydev);
```

## Arguments

*phydev* the target `phy_device` struct

## Description

Make sure the PHY is set to supported speeds and duplexes. Drop down by one in this order: 1000/FULL, 1000/HALF, 100/FULL, 100/HALF, 10/FULL, 10/HALF.

## Name

`phy_start_machine` — start PHY state machine tracking

## Synopsis

```
void phy_start_machine (struct phy_device * phydev);
```

## Arguments

*phydev* the `phy_device` struct

## Description

The PHY infrastructure can run a state machine which tracks whether the PHY is starting up, negotiating, etc. This function starts the timer which tracks the state of the PHY. If you want to maintain your own state machine, do not call this function.

## Name

`phy_stop_machine` — stop the PHY state machine tracking

## Synopsis

```
void phy_stop_machine (struct phy_device * phydev);
```

## Arguments

*phydev*    target `phy_device` struct

## Description

Stops the state machine timer, sets the state to UP (unless it wasn't up yet). This function must be called BEFORE `phy_detach`.

## Name

`phy_error` — enter HALTED state for this PHY device

## Synopsis

```
void phy_error (struct phy_device * phydev);
```

## Arguments

*phydev*    target `phy_device` struct

## Description

Moves the PHY to the HALTED state in response to a read or write error, and tells the controller the link is down. Must not be called from interrupt context, or while the `phydev->lock` is held.

## Name

`phy_interrupt` — PHY interrupt handler

## Synopsis

```
irqreturn_t phy_interrupt (int irq, void * phy_dat);
```

## Arguments

*irq*            interrupt line

*phy\_dat*    phy\_device pointer

## Description

When a PHY interrupt occurs, the handler disables interrupts, and schedules a work task to clear the interrupt.

## Name

`phy_enable_interrupts` — Enable the interrupts from the PHY side

## Synopsis

```
int phy_enable_interrupts (struct phy_device * phydev);
```

## Arguments

*phydev*    target `phy_device` struct



## Name

`phy_disable_interrupts` — Disable the PHY interrupts from the PHY side

## Synopsis

```
int phy_disable_interrupts (struct phy_device * phydev);
```

## Arguments

*phydev*    target `phy_device` struct

## Name

`phy_change` — Scheduled by the `phy_interrupt`/timer to handle PHY changes

## Synopsis

```
void phy_change (struct work_struct * work);
```

## Arguments

*work*    `work_struct` that describes the work to be done

## Name

`phy_state_machine` — Handle the state machine

## Synopsis

```
void phy_state_machine (struct work_struct * work);
```

## Arguments

*work*    `work_struct` that describes the work to be done

## Name

`phy_read_mmd_indirect` — reads data from the MMD registers

## Synopsis

```
int phy_read_mmd_indirect (struct mii_bus * bus, int prtad, int devad,  
int addr);
```

## Arguments

*bus*      the target MII bus

*prtad*    MMD Address

*devad*    MMD DEVAD

*addr*     PHY address on the MII bus

## Description

it reads data from the MMD registers (clause 22 to access to clause 45) of the specified phy address.

## To read these register we have

1) Write reg 13 // DEVAD 2) Write reg 14 // MMD Address 3) Write reg 13 // MMD Data Command for MMD DEVAD 3) Read reg 14 // Read MMD data

## Name

`phy_write_mmd_indirect` — writes data to the MMD registers

## Synopsis

```
void phy_write_mmd_indirect (struct mii_bus * bus, int prtad, int devad,  
int addr, u32 data);
```

## Arguments

*bus*      the target MII bus

*prtad*    MMD Address

*devad*    MMD DEVAD

*addr*     PHY address on the MII bus

*data*     data to write in the MMD register

## Description

Write data from the MMD registers of the specified phy address.

## To write these register we have

1) Write reg 13 // DEVAD 2) Write reg 14 // MMD Address 3) Write reg 13 // MMD Data Command for MMD DEVAD 3) Write reg 14 // Write MMD data

## Name

`phy_register_fixup` — creates a new `phy_fixup` and adds it to the list

## Synopsis

```
int phy_register_fixup (const char * bus_id, u32 phy_uid, u32
phy_uid_mask, int (*run) (struct phy_device *));
```

## Arguments

<i>bus_id</i>	A string which matches <code>phydev-&gt;dev.bus_id</code> (or <code>PHY_ANY_ID</code> )
<i>phy_uid</i>	Used to match against <code>phydev-&gt;phy_id</code> (the UID of the PHY) It can also be <code>PHY_ANY_UID</code>
<i>phy_uid_mask</i>	Applied to <code>phydev-&gt;phy_id</code> and <code>fixup-&gt;phy_uid</code> before comparison
<i>run</i>	The actual code to be run when a matching PHY is found

## Name

`get_phy_device` — reads the specified PHY device and returns its *phy\_device* struct

## Synopsis

```
struct phy_device * get_phy_device (struct mii_bus * bus, int addr,  
bool is_c45);
```

## Arguments

*bus*        the target MII bus

*addr*       PHY address on the MII bus

*is\_c45*     If true the PHY uses the 802.3 clause 45 protocol

## Description

Reads the ID registers of the PHY at *addr* on the *bus*, then allocates and returns the *phy\_device* to represent it.

## Name

`phy_device_register` — Register the phy device on the MDIO bus

## Synopsis

```
int phy_device_register (struct phy_device * phydev);
```

## Arguments

*phydev*    `phy_device` structure to be added to the MDIO bus



## Name

`phy_find_first` — finds the first PHY device on the bus

## Synopsis

```
struct phy_device * phy_find_first (struct mii_bus * bus);
```

## Arguments

*bus* the target MII bus

## Name

`phy_connect_direct` — connect an ethernet device to a specific `phy_device`

## Synopsis

```
int phy_connect_direct (struct net_device * dev, struct phy_device
* phydev, void (*handler) (struct net_device *), phy_interface_t
interface);
```

## Arguments

<i>dev</i>	the network device to connect
<i>phydev</i>	the pointer to the phy device
<i>handler</i>	callback function for state change notifications
<i>interface</i>	PHY device's interface

## Name

`phy_connect` — connect an ethernet device to a PHY device

## Synopsis

```
struct phy_device * phy_connect (struct net_device * dev, const char  
* bus_id, void (*handler) (struct net_device *), phy_interface_t  
interface);
```

## Arguments

<i>dev</i>	the network device to connect
<i>bus_id</i>	the id string of the PHY device to connect
<i>handler</i>	callback function for state change notifications
<i>interface</i>	PHY device's interface

## Description

Convenience function for connecting ethernet devices to PHY devices. The default behavior is for the PHY infrastructure to handle everything, and only notify the connected driver when the link status changes. If you don't want, or can't use the provided functionality, you may choose to call only the subset of functions which provide the desired functionality.

## Name

`phy_disconnect` — disable interrupts, stop state machine, and detach a PHY device

## Synopsis

```
void phy_disconnect (struct phy_device * phydev);
```

## Arguments

*phydev*    target `phy_device` struct

## Name

`phy_attach_direct` — attach a network device to a given PHY device pointer

## Synopsis

```
int phy_attach_direct (struct net_device * dev, struct phy_device *  
phydev, u32 flags, phy_interface_t interface);
```

## Arguments

<i>dev</i>	network device to attach
<i>phydev</i>	Pointer to <code>phy_device</code> to attach
<i>flags</i>	PHY device's <code>dev_flags</code>
<i>interface</i>	PHY device's interface

## Description

Called by drivers to attach to a particular PHY device. The `phy_device` is found, and properly hooked up to the `phy_driver`. If no driver is attached, then a generic driver is used. The `phy_device` is given a ptr to the attaching device, and given a callback for link status change. The `phy_device` is returned to the attaching driver.

## Name

`phy_attach` — attach a network device to a particular PHY device

## Synopsis

```
struct phy_device * phy_attach (struct net_device * dev, const char *  
bus_id, phy_interface_t interface);
```

## Arguments

<i>dev</i>	network device to attach
<i>bus_id</i>	Bus ID of PHY device to attach
<i>interface</i>	PHY device's interface

## Description

Same as `phy_attach_direct` except that a PHY `bus_id` string is passed instead of a pointer to a struct `phy_device`.

## Name

`phy_detach` — detach a PHY device from its network device

## Synopsis

```
void phy_detach (struct phy_device * phydev);
```

## Arguments

*phydev*    target `phy_device` struct

## Name

`genphy_setup_forced` — configures/forces speed/duplex from *phydev*

## Synopsis

```
int genphy_setup_forced (struct phy_device * phydev);
```

## Arguments

*phydev*    target phy\_device struct

## Description

Configures MII\_BMCR to force speed/duplex to the values in *phydev*. Assumes that the values are valid. Please see `phy_sanitize_settings`.



## Name

genphy\_restart\_aneg — Enable and Restart Autonegotiation

## Synopsis

```
int genphy_restart_aneg (struct phy_device * phydev);
```

## Arguments

*phydev* target phy\_device struct

## Name

`genphy_config_aneg` — restart auto-negotiation or write BMCR

## Synopsis

```
int genphy_config_aneg (struct phy_device * phydev);
```

## Arguments

*phydev*   target `phy_device` struct

## Description

If auto-negotiation is enabled, we configure the advertising, and then restart auto-negotiation. If it is not enabled, then we write the BMCR.

## Name

`genphy_aneg_done` — return auto-negotiation status

## Synopsis

```
int genphy_aneg_done (struct phy_device * phydev);
```

## Arguments

*phydev*    target `phy_device` struct

## Description

Reads the status register and returns 0 either if auto-negotiation is incomplete, or if there was an error. Returns `BMSR_ANEGCOMPLETE` if auto-negotiation is done.

## Name

`genphy_update_link` — update link status in *phydev*

## Synopsis

```
int genphy_update_link (struct phy_device * phydev);
```

## Arguments

*phydev*   target phy\_device struct

## Description

Update the value in `phydev->link` to reflect the current link value. In order to do this, we need to read the status register twice, keeping the second value.

## Name

`genphy_read_status` — check the link status and update current link state

## Synopsis

```
int genphy_read_status (struct phy_device * phydev);
```

## Arguments

*phydev*    target `phy_device` struct

## Description

Check the link, then figure out the current state by comparing what we advertise with what the link partner advertises. Start by checking the gigabit possibilities, then move on to 10/100.

## Name

`genphy_soft_reset` — software reset the PHY via BMCR\_RESET bit

## Synopsis

```
int genphy_soft_reset (struct phy_device * phydev);
```

## Arguments

*phydev* target phy\_device struct

## Description

Perform a software PHY reset using the standard BMCR\_RESET bit and poll for the reset bit to be cleared.

## Returns

0 on success, < 0 on failure

## Name

`phy_driver_register` — register a `phy_driver` with the PHY layer

## Synopsis

```
int phy_driver_register (struct phy_driver * new_driver);
```

## Arguments

*new\_driver*    new `phy_driver` to register

## Name

`get_phy_c45_ids` — reads the specified `addr` for its 802.3-c45 IDs.

## Synopsis

```
int get_phy_c45_ids (struct mii_bus * bus, int addr, u32 * phy_id,  
struct phy_c45_device_ids * c45_ids);
```

## Arguments

<i>bus</i>	the target MII bus
<i>addr</i>	PHY address on the MII bus
<i>phy_id</i>	where to store the ID retrieved.
<i>c45_ids</i>	where to store the c45 ID information.

## Description

If the PHY devices-in-package appears to be valid, it and the corresponding identifiers are stored in *c45\_ids*, zero is stored in *phy\_id*. Otherwise 0xffffffff is stored in *phy\_id*. Returns zero on success.



## Name

`get_phy_id` — reads the specified `addr` for its ID.

## Synopsis

```
int get_phy_id (struct mii_bus * bus, int addr, u32 * phy_id, bool
is_c45, struct phy_c45_device_ids * c45_ids);
```

## Arguments

<i>bus</i>	the target MII bus
<i>addr</i>	PHY address on the MII bus
<i>phy_id</i>	where to store the ID retrieved.
<i>is_c45</i>	If true the PHY uses the 802.3 clause 45 protocol
<i>c45_ids</i>	where to store the c45 ID information.

## Description

In the case of a 802.3-c22 PHY, reads the ID registers of the PHY at *addr* on the *bus*, stores it in *phy\_id* and returns zero on success.

In the case of a 802.3-c45 PHY, `get_phy_c45_ids` is invoked, and its return value is in turn returned.

## Name

`phy_prepare_link` — prepares the PHY layer to monitor link status

## Synopsis

```
void phy_prepare_link (struct phy_device * phydev, void (*handler)
(struct net_device *));
```

## Arguments

*phydev*    target `phy_device` struct

*handler*   callback function for link status change notifications

## Description

Tells the PHY infrastructure to handle the gory details on monitoring link status (whether through polling or an interrupt), and to call back to the connected device driver when the link status changes. If you want to monitor your own link state, don't call this function.

## Name

`phy_poll_reset` — Safely wait until a PHY reset has properly completed

## Synopsis

```
int phy_poll_reset (struct phy_device * phydev);
```

## Arguments

*phydev*    The PHY device to poll

## Description

According to IEEE 802.3, Section 2, Subsection 22.2.4.1.1, as published in 2008, a PHY reset may take up to 0.5 seconds. The MII BMCR register must be polled until the BMCR\_RESET bit clears.

Furthermore, any attempts to write to PHY registers may have no effect or even generate MDIO bus errors until this is complete.

Some PHYs (such as the Marvell 88E1111) don't entirely conform to the standard and do not fully reset after the BMCR\_RESET bit is set, and may even *\*REQUIRE\** a soft-reset to properly restart autonegotiation. In an effort to support such broken PHYs, this function is separate from the standard `phy_init_hw` which will zero all the other bits in the BMCR and reapply all driver-specific and board-specific fixups.

## Name

`genphy_config_advert` — sanitize and advertise auto-negotiation parameters

## Synopsis

```
int genphy_config_advert (struct phy_device * phydev);
```

## Arguments

*phydev*    target `phy_device` struct

## Description

Writes `MII_ADVERTISE` with the appropriate values, after sanitizing the values to make sure we only advertise what is supported. Returns `< 0` on error, `0` if the PHY's advertisement hasn't changed, and `> 0` if it has changed.

## Name

`phy_probe` — probe and init a PHY device

## Synopsis

```
int phy_probe (struct device * dev);
```

## Arguments

*dev* device to probe and init

## Description

Take care of setting up the `phy_device` structure, set the state to `READY` (the driver's init function should set it to `STARTING` if needed).

## Name

`mdiobus_alloc_size` — allocate a `mii_bus` structure

## Synopsis

```
struct mii_bus * mdiobus_alloc_size (size_t size);
```

## Arguments

*size* extra amount of memory to allocate for private storage. If non-zero, then `bus->priv` is points to that memory.

## Description

called by a bus driver to allocate an `mii_bus` structure to fill in.

## Name

`devm_mdio_alloc_size` — Resource-managed `mdio_alloc_size`

## Synopsis

```
struct mii_bus * devm_mdio_alloc_size (struct device * dev, int
sizeof_priv);
```

## Arguments

*dev*                    Device to allocate `mii_bus` for

*sizeof\_priv*    Space to allocate for private structure.

## Description

Managed `mdio_alloc_size`. `mii_bus` allocated with this function is automatically freed on driver detach.

If an `mii_bus` allocated with this function needs to be freed separately, `devm_mdio_free` must be used.

## RETURNS

Pointer to allocated `mii_bus` on success, NULL on failure.

## Name

devm\_mdiodbus\_free — Resource-managed mdiobus\_free

## Synopsis

```
void devm_mdiodbus_free (struct device * dev, struct mii_bus * bus);
```

## Arguments

*dev* Device this mii\_bus belongs to

*bus* the mii\_bus associated with the device

## Description

Free mii\_bus allocated with devm\_mdiodbus\_alloc\_size.



## Name

`of_mdio_find_bus` — Given an `mii_bus` node, find the `mii_bus`.

## Synopsis

```
struct mii_bus * of_mdio_find_bus (struct device_node * mdio_bus_np);
```

## Arguments

*mdio\_bus\_np* Pointer to the `mii_bus`.

## Description

Returns a pointer to the `mii_bus`, or NULL if none found.

Because the association of a `device_node` and `mii_bus` is made via `of_mdio_register`, the `mii_bus` cannot be found before it is registered with `of_mdio_register`.

## Name

`mdiobus_register` — bring up all the PHYs on a given bus and attach them to bus

## Synopsis

```
int mdiobus_register (struct mii_bus * bus);
```

## Arguments

*bus*   target mii\_bus

## Description

Called by a bus driver to bring up all the PHYs on a given bus, and attach them to the bus.

Returns 0 on success or < 0 on error.

## Name

`mdiobus_free` — free a struct `mii_bus`

## Synopsis

```
void mdiobus_free (struct mii_bus * bus);
```

## Arguments

*bus*    `mii_bus` to free

## Description

This function releases the reference to the underlying device object in the `mii_bus`. If this is the last reference, the `mii_bus` will be freed.

## Name

`mdiobus_read` — Convenience function for reading a given MII mgmt register

## Synopsis

```
int mdiobus_read (struct mii_bus * bus, int addr, u32 regnum);
```

## Arguments

*bus*        the mii\_bus struct

*addr*       the phy address

*regnum*    register number to read

## NOTE

MUST NOT be called from interrupt context, because the bus read/write functions may wait for an interrupt to conclude the operation.

## Name

`mdiobus_write` — Convenience function for writing a given MII mgmt register

## Synopsis

```
int mdiobus_write (struct mii_bus * bus, int addr, u32 regnum, u16 val);
```

## Arguments

<i>bus</i>	the <code>mii_bus</code> struct
<i>addr</i>	the phy address
<i>regnum</i>	register number to write
<i>val</i>	value to write to <i>regnum</i>

## NOTE

MUST NOT be called from interrupt context, because the bus read/write functions may wait for an interrupt to conclude the operation.

## Name

mdiobus\_release — mii\_bus device release callback

## Synopsis

```
void mdiobus_release (struct device * d);
```

## Arguments

*d* the target struct device that contains the mii\_bus

## Description

called when the last reference to an mii\_bus is dropped, to free the underlying memory.

## Name

`mdio_bus_match` — determine if given PHY driver supports the given PHY device

## Synopsis

```
int mdio_bus_match (struct device * dev, struct device_driver * drv);
```

## Arguments

*dev* target PHY device

*drv* given PHY driver

## Description

Given a PHY device, and a PHY driver, return 1 if the driver supports the device. Otherwise, return 0.