

Linux Networking and Network Devices APIs

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Chapter 1. Linux Networking

1.1. Networking Base Types

enum sock_type

LINUX

Kernel Hackers Manual January 2009

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.

struct socket

LINUX

Kernel Hackers Manual January 2009

Name

`struct socket` — general BSD socket

Synopsis

```
struct socket {
    socket_state state;
    unsigned long flags;
    const struct proto_ops * ops;
    struct fasync_struct * fasync_list;
    struct file * file;
```

```
struct sock * sk;  
wait_queue_head_t wait;  
short type;  
};
```

Members

state

socket state (SS_CONNECTED, etc)

flags

socket flags (SOCK_ASYNC_NOSPACE, etc)

ops

protocol specific socket operations

fasync_list

Asynchronous wake up list

file

File back pointer for gc

sk

internal networking protocol agnostic socket representation

wait

wait queue for several uses

type

socket type (SOCK_STREAM, etc)

1.2. Socket Buffer Functions

struct sk_buff

LINUX

Kernel Hackers Manual January 2009

Name

struct sk_buff — socket buffer

Synopsis

```
struct sk_buff {
    struct sk_buff * next;
    struct sk_buff * prev;
    struct sock * sk;
    ktime_t tstamp;
    struct net_device * dev;
    struct dst_entry * dst;
    struct sec_path * sp;
    char cb[48];
    unsigned int len;
    unsigned int data_len;
    __u16 mac_len;
    __u16 hdr_len;
    union {unnamed_union};
    __u32 priority;
    __u8 local_df:1;
    __u8 cloned:1;
    __u8 ip_summed:2;
    __u8 nohdr:1;
    __u8 nfctinfo:3;
    __u8 pkt_type:3;
    __u8 fclone:2;
    __u8 ipvs_property:1;
    __u8 peeked:1;
    __u8 nf_trace:1;
    __be16 protocol;
    void (* destructor) (struct sk_buff *skb);
#ifdef CONFIG_NF_CONNTRACK || defined(CONFIG_NF_CONNTRACK_MODULE)
    struct nf_conntrack * nfct;
#endif
};
```

```

    struct sk_buff * nfct_reasm;
#endif
#ifdef CONFIG_BRIDGE_NETFILTER
    struct nf_bridge_info * nf_bridge;
#endif
    int iif;
#ifdef CONFIG_NETDEVICES_MULTIQUEUE
    __u16 queue_mapping;
#endif
#ifdef CONFIG_NET_SCHED
    __u16 tc_index;
#endif
#ifdef CONFIG_NET_CLS_ACT
    __u16 tc_verd;
#endif
#endif
#ifdef CONFIG_XEN
#else
    __u8 proto_data_valid:1;
    __u8 proto_csum_blank:1;
#endif
#ifdef CONFIG_NET_DMA
    dma_cookie_t dma_cookie;
#endif
#ifdef CONFIG_NETWORK_SECMARK
    __u32 secmark;
#endif
    __u32 mark;
    sk_buff_data_t transport_header;
    sk_buff_data_t network_header;
    sk_buff_data_t 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

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prev

Previous buffer in list

sk

Socket we are owned by

tstamp

Time we arrived

dev

Device we arrived on/are leaving by

dst

destination entry

sp

the security path, used for xfrm

cb[48]

Control buffer. Free for use by every layer. Put private vars here

len

Length of actual data

data_len

Data length

mac_len

Length of link layer header

hdr_len

writable header length of cloned skb

{unnamed_union}

anonymous

priority

Packet queueing priority

local_df

allow local fragmentation

cloned

Head may be cloned (check refcnt to be sure)

ip_summed

Driver fed us an IP checksum

nohdr

Payload reference only, must not modify header

nfctinfo

Relationship of this skb to the connection

pkt_type

Packet class

fclone

skbuff clone status

ipvs_property

skbuff is owned by ipvs

peeked

this packet has been seen already, so stats have been done for it, don't do them again

nf_trace

netfilter packet trace flag

protocol

Packet protocol from driver

destructor

Destruct function

nfct

Associated connection, if any

nfct_reasm

netfilter conntrack re-assembly pointer

Chapter 1. Linux Networking

`nf_bridge`

Saved data about a bridged frame - see `br_netfilter.c`

`iif`

ifindex of device we arrived on

`queue_mapping`

Queue mapping for multiqueue devices

`tc_index`

Traffic control index

`tc_verd`

traffic control verdict

`proto_data_valid`

Protocol data validated since arriving at localhost

`proto_csum_blank`

Protocol csum must be added before leaving localhost

`dma_cookie`

a cookie to one of several possible DMA operations done by skb DMA functions

`secmark`

security marking

`mark`

Generic packet mark

`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

skb_queue_empty

LINUX

Kernel Hackers Manual January 2009

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.

skb_get

LINUX

Kernel Hackers Manual January 2009

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.

skb_cloned

LINUX

Kernel Hackers Manual January 2009

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.

skb_header_cloned

LINUX

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.

skb_header_release

LINUX

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.

skb_shared

LINUX

Kernel Hackers Manual January 2009

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.

skb_share_check

LINUX

Kernel Hackers Manual January 2009

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.

skb_unshare

LINUX

Kernel Hackers Manual January 2009

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.

skb_peek

LINUX

Kernel Hackers Manual January 2009

Name

skb_peek —

Synopsis

```
struct sk_buff * skb_peek (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.

skb_peek_tail

LINUX

Kernel Hackers Manual January 2009

Name

`skb_peek_tail` —

Synopsis

```
struct sk_buff * skb_peek_tail (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.

skb_queue_len

LINUX

Kernel Hackers Manual January 2009

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.

__skb_queue_after

LINUX

Kernel Hackers Manual January 2009

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.

skb_put

LINUX

Kernel Hackers Manual January 2009

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.

skb_push

LINUX

Kernel Hackers Manual January 2009

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.

skb_pull

LINUX

Kernel Hackers Manual January 2009

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.

skb_headroom

LINUX

Kernel Hackers Manual January 2009

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`.

skb_tailroom

LINUX

Kernel Hackers Manual January 2009

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`

skb_reserve

LINUX

Kernel Hackers Manual January 2009

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.

skb_trim

LINUX

Kernel Hackers Manual January 2009

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.

pskb_trim_unique

LINUX

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.

`skb_orphan`

LINUX

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.

__dev_alloc_skb

LINUX

Name

`__dev_alloc_skb` — allocate an skbuff for receiving

Synopsis

```
struct sk_buff * __dev_alloc_skb (unsigned int length, gfp_t  
gfp_mask);
```

Arguments

length

length to allocate

gfp_mask

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.

dev_alloc_skb

LINUX

Kernel Hackers Manual January 2009

Name

dev_alloc_skb — allocate an skbuff for receiving

Synopsis

```
struct sk_buff * dev_alloc_skb (unsigned int length);
```

Arguments

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.

netdev_alloc_skb

LINUX

Kernel Hackers Manual January 2009

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.

skb_clone_writable

LINUX

Kernel Hackers Manual January 2009

Name

`skb_clone_writable` — is the header of a clone writable

Synopsis

```
int skb_clone_writable (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.

skb_cow

LINUX

Kernel Hackers Manual January 2009

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.

skb_cow_head

LINUX

Kernel Hackers Manual January 2009

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.

skb_padto

LINUX

Kernel Hackers Manual January 2009

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.

skb_linearize

LINUX

Kernel Hackers Manual January 2009

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.

skb_linearize_cow

LINUX

Kernel Hackers Manual January 2009

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.

skb_postpull_rcsum

LINUX

Kernel Hackers Manual January 2009

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.

pskb_trim_rcsum

LINUX

Kernel Hackers Manual January 2009

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.

skb_get_timestamp

LINUX

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.

skb_checksum_complete

LINUX

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.

struct sock_common

LINUX

Name

`struct sock_common` — minimal network layer representation of sockets

Synopsis

```
struct sock_common {
    unsigned short skc_family;
    volatile unsigned char skc_state;
    unsigned char skc_reuse;
    int skc_bound_dev_if;
    struct hlist_node skc_node;
    struct hlist_node skc_bind_node;
    atomic_t skc_refcnt;
    unsigned int skc_hash;
    struct proto * skc_prot;
    struct net * skc_net;
};
```

Members

`skc_family`

network address family

`skc_state`

Connection state

`skc_reuse`

`SO_REUSEADDR` setting

`skc_bound_dev_if`

bound device index if != 0

`skc_node`

main hash linkage for various protocol lookup tables

`skc_bind_node`

bind hash linkage for various protocol lookup tables

skc_refcnt

reference count

skc_hash

hash value used with various protocol lookup tables

skc_prot

protocol handlers inside a network family

skc_net

reference to the network namespace of this socket

Description

This is the minimal network layer representation of sockets, the header for struct sock and struct inet_timewait_sock.

struct sock

LINUX

Kernel Hackers Manual January 2009

Name

struct sock — network layer representation of sockets

Synopsis

```
struct sock {
    struct sock_common __sk_common;
#define sk_family    __sk_common.skc_family
#define sk_state     __sk_common.skc_state
#define sk_reuse     __sk_common.skc_reuse
#define sk_bound_dev_if __sk_common.skc_bound_dev_if
#define sk_node      __sk_common.skc_node
#define sk_bind_node __sk_common.skc_bind_node
```

```
#define sk_refcnt    __sk_common.skc_refcnt
#define sk_hash      __sk_common.skc_hash
#define sk_prot      __sk_common.skc_prot
#define sk_net       __sk_common.skc_net
    unsigned char sk_shutdown:2;
    unsigned char sk_no_check:2;
    unsigned char sk_userlocks:4;
    unsigned char sk_protocol;
    unsigned short sk_type;
    int sk_rcvbuf;
    socket_lock_t sk_lock;
    struct sk_backlog;
    wait_queue_head_t * sk_sleep;
    struct dst_entry * sk_dst_cache;
    struct xfrm_policy * sk_policy[2];
    rwlock_t sk_dst_lock;
    atomic_t sk_rmem_alloc;
    atomic_t sk_wmem_alloc;
    atomic_t sk_omem_alloc;
    int sk_sndbuf;
    struct sk_buff_head sk_receive_queue;
    struct sk_buff_head sk_write_queue;
    struct sk_buff_head sk_async_wait_queue;
    int sk_wmem_queued;
    int sk_forward_alloc;
    gfp_t sk_allocation;
    int sk_route_caps;
    int sk_gso_type;
    int sk_rcvlowat;
    unsigned long sk_flags;
    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;
    atomic_t sk_drops;
    unsigned short sk_ack_backlog;
    unsigned short sk_max_ack_backlog;
    __u32 sk_priority;
    struct ucred sk_peercred;
    long sk_rcvtimeo;
    long sk_sndtimeo;
    struct sk_filter * sk_filter;
    void * sk_protinfo;
    struct timer_list sk_timer;
    ktime_t sk_stamp;
    struct socket * sk_socket;
```

```
void * sk_user_data;
struct page * sk_sndmsg_page;
struct sk_buff * sk_send_head;
__u32 sk_sndmsg_off;
int sk_write_pending;
void * sk_security;
__u32 sk_mark;
void (* sk_state_change) (struct sock *sk);
void (* sk_data_ready) (struct sock *sk, int bytes);
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_shutdown`

mask of `SEND_SHUTDOWN` and/or `RCV_SHUTDOWN`

`sk_no_check`

`SO_NO_CHECK` setting, whether or not checkup packets

`sk_userlocks`

`SO_SNDBUF` and `SO_RCVBUF` settings

`sk_protocol`

which protocol this socket belongs in this network family

`sk_type`

socket type (`SOCK_STREAM`, etc)

`sk_rcvbuf`

size of receive buffer in bytes

`sk_lock`

synchronizer

`sk_backlog`
always used with the per-socket spinlock held

`sk_sleep`
sock wait queue

`sk_dst_cache`
destination cache

`sk_policy[2]`
flow policy

`sk_dst_lock`
destination cache lock

`sk_rmem_alloc`
receive queue bytes committed

`sk_wmem_alloc`
transmit queue bytes committed

`sk_omem_alloc`
"o" is "option" or "other"

`sk_sndbuf`
size of send buffer in bytes

`sk_receive_queue`
incoming packets

`sk_write_queue`
Packet sending queue

`sk_async_wait_queue`
DMA copied packets

`sk_wmem_queued`
persistent queue size

`sk_forward_alloc`
space allocated forward

`sk_allocation`

allocation mode

`sk_route_caps`

route capabilities (e.g. `NETIF_F_TSO`)

`sk_gso_type`

GSO type (e.g. `SKB_GSO_TCPV4`)

`sk_rcvlowat`

`SO_RCVLOWAT` setting

`sk_flags`

`SO_LINGER` (`l_onoff`), `SO_BROADCAST`, `SO_KEEPALIVE`, `SO_OOBINLINE` settings

`sk_lingertime`

`SO_LINGER` `l_linger` setting

`sk_error_queue`

rarely used

`sk_prot_creator`

`sk_prot` of original sock creator (see `ipv6_setsockopt`, `IPV6_ADDRFORM` for instance)

`sk_callback_lock`

used with the callbacks in the end of this struct

`sk_err`

last error

`sk_err_soft`

errors that don't cause failure but are the cause of a persistent failure not just 'timed out'

`sk_drops`

raw drops counter

`sk_ack_backlog`

current listen backlog

`sk_max_ack_backlog`

listen backlog set in `listen`

`sk_priority`

`SO_PRIORITY` setting

`sk_peercred`

`SO_PEERCRED` setting

`sk_rcvtimeo`

`SO_RCVTIMEO` setting

`sk_sndtimeo`

`SO_SNDTIMEO` setting

`sk_filter`

socket filtering instructions

`sk_protinfo`

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_sndmsg_page`

cached page for `sendmsg`

`sk_send_head`

front of stuff to transmit

`sk_sndmsg_off`

cached offset for `sendmsg`

`sk_write_pending`

a write to stream socket waits to start

`sk_security`

used by security modules

`sk_mark`

generic packet mark

`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`

sk_filter

LINUX

Kernel Hackers Manual January 2009

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.

sk_filter_release

LINUX

Kernel Hackers Manual January 2009

Name

sk_filter_release —

Synopsis

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

Arguments

fp

filter to remove

Description

Remove a filter from a socket and release its resources.

sk_eat_skb

LINUX

Kernel Hackers Manual January 2009

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, int  
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.

move_addr_to_kernel

LINUX

Kernel Hackers Manual January 2009

Name

`move_addr_to_kernel` — copy a socket address into kernel space

Synopsis

```
int move_addr_to_kernel (void __user * uaddr, int ulen, void *  
kaddr);
```

Arguments

uaddr

Address in user space

ulen

Length in user space

kaddr

Address in kernel space

Description

The address is copied into kernel space. If the provided address is too long an error code of `-EINVAL` is returned. If the copy gives invalid addresses `-EFAULT` is returned. On a success 0 is returned.

move_addr_to_user

LINUX

Kernel Hackers Manual January 2009

Name

`move_addr_to_user` — copy an address to user space

Synopsis

```
int move_addr_to_user (void * kaddr, int klen, void __user *  
uaddr, int __user * ulen);
```

Arguments

kaddr

kernel space address

klen

length of address in kernel

uaddr

user space address

ulen

pointer to user length field

Description

The value pointed to by *ulen* on entry is the buffer length available. This is overwritten with the buffer space used. -EINVAL is returned if an overlong buffer is specified or a negative buffer size. -EFAULT is returned if either the buffer or the length field are not accessible. After copying the data up to the limit the user specifies, the true length of the data is written over the length limit the user specified. Zero is returned for a success.

sockfd_lookup

LINUX

Kernel Hackers Manual January 2009

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.

sock_release

LINUX

Kernel Hackers Manual January 2009

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.

sock_register

LINUX

Kernel Hackers Manual January 2009

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.

sock_unregister

LINUX

Kernel Hackers Manual January 2009

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.

skb_over_panic

LINUX

Kernel Hackers Manual January 2009

Name

`skb_over_panic` — private function

Synopsis

```
void skb_over_panic (struct sk_buff * skb, int sz, void *  
here);
```

Arguments

skb

buffer

sz

size

here

address

Description

Out of line support code for `skb_put`. Not user callable.

skb_under_panic

LINUX

Kernel Hackers Manual January 2009

Name

skb_under_panic — private function

Synopsis

```
void skb_under_panic (struct sk_buff * skb, int sz, void *  
here);
```

Arguments

skb

buffer

sz

size

here

address

Description

Out of line support code for `skb_push`. Not user callable.

__alloc_skb

LINUX

Kernel Hackers Manual January 2009

Name

`__alloc_skb` — allocate a network buffer

Synopsis

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

Arguments

size

size to allocate

gfp_mask

allocation mask

fclone

allocate from fclone cache instead of head cache and allocate a cloned (child)
skb

node

numa node to allocate memory on

Description

Allocate a new `sk_buff`. The returned buffer has no headroom and a tail room of `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.

__netdev_alloc_skb

LINUX

Kernel Hackers Manual January 2009

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

dev

network device to receive on

length

length to allocate

gfp_mask

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.

__kfree_skb

LINUX

Kernel Hackers Manual January 2009

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

kfree_skb

LINUX

Kernel Hackers Manual January 2009

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.

skb_morph

LINUX

Kernel Hackers Manual January 2009

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.

skb_clone

LINUX

Kernel Hackers Manual January 2009

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`.

skb_copy

LINUX

Kernel Hackers Manual January 2009

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.

pskb_copy

LINUX

Kernel Hackers Manual January 2009

Name

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

Synopsis

```
struct sk_buff * pskb_copy (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 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.

pskb_expand_head

LINUX

Kernel Hackers Manual January 2009

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

skb

buffer to reallocate

nhead

room to add at head

ntail

room to add at tail

gfp_mask

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.

skb_copy_expand

LINUX

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

skb

buffer to copy

newheadroom

new free bytes at head

newtailroom

new free bytes at tail

gfp_mask

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.

skb_pad

LINUX

Kernel Hackers Manual January 2009

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.

__pskb_pull_tail

LINUX

Kernel Hackers Manual January 2009

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.

skb_store_bits

LINUX

Kernel Hackers Manual January 2009

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

skb

destination buffer

offset

offset in destination

from

source buffer

len

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.

skb_dequeue

LINUX

Kernel Hackers Manual January 2009

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.

skb_dequeue_tail

LINUX

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.

skb_queue_purge

LINUX

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.

skb_queue_head

LINUX

Kernel Hackers Manual January 2009

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.

skb_queue_tail

LINUX

Kernel Hackers Manual January 2009

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.

skb_unlink

LINUX

Kernel Hackers Manual January 2009

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.

skb_append

LINUX

Kernel Hackers Manual January 2009

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.

skb_insert

LINUX

Kernel Hackers Manual January 2009

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.

skb_split

LINUX

Kernel Hackers Manual January 2009

Name

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

Synopsis

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


Arguments

skb

the buffer to split

skb1

the buffer to receive the second part

len

new length for skb

skb_prepare_seq_read

LINUX

Kernel Hackers Manual January 2009

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.

skb_seq_read

LINUX

Kernel Hackers Manual January 2009

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.

skb_abort_seq_read

LINUX

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.

skb_find_text

LINUX

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

skb

the buffer to look in

from

search offset

to

search limit

config

textsearch configuration

state

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.

skb_append_datato_fragments

LINUX

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

sk

sock structure

skb

skb structure to be appened with user data.

getfrag

call back function to be used for getting the user data

from

pointer to user message iov

length

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

skb_pull_rcsum

LINUX

Kernel Hackers Manual January 2009

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`.

skb_segment

LINUX

Kernel Hackers Manual January 2009

Name

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

Synopsis

```
struct sk_buff * skb_segment (struct sk_buff * skb, int
features);
```

Arguments

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)`.

skb_cow_data

LINUX

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.

skb_partial_csum_set

LINUX

Kernel Hackers Manual January 2009

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.

sk_alloc

LINUX

Kernel Hackers Manual January 2009

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

net

the applicable net namespace

family

protocol family

priority

for allocation (GFP_KERNEL, GFP_ATOMIC, etc)

prot

struct proto associated with this new sock instance

sk_wait_data

LINUX

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.

__sk_mem_schedule

LINUX

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.

`__sk_mem_reclaim`

LINUX

Name

`__sk_mem_reclaim` — reclaim memory_allocated

Synopsis

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

Arguments

sk
socket

`__skb_recv_datagram`

LINUX

Name

`__skb_recv_datagram` — Receive a datagram skbuff

Synopsis

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

Arguments

skb

socket

flags

MSG_ flags

peeked

returns non-zero if this packet has been seen before

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.

skb_kill_datagram

LINUX

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.

skb_copy_datagram_iovec

LINUX

Kernel Hackers Manual January 2009

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

skb

buffer to copy

offset

offset in the buffer to start copying from

to

io vector to copy to

len

amount of data to copy from buffer to iovec

Note

the iovec is modified during the copy.

skb_copy_and_csum_datagram_iovec

LINUX

Kernel Hackers Manual January 2009

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!

datagram_poll

LINUX

Kernel Hackers Manual January 2009

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.

sk_stream_write_space

LINUX

Kernel Hackers Manual January 2009

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

sk_stream_wait_connect

LINUX

Kernel Hackers Manual January 2009

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.

sk_stream_wait_memory

LINUX

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

1.3. Socket Filter

sk_run_filter

LINUX

Name

`sk_run_filter` — run a filter on a socket

Synopsis

```
unsigned int sk_run_filter (struct sk_buff * skb, struct  
sock_filter * filter, int flen);
```

Arguments

skb

buffer to run the filter on

filter

filter to apply

flen

length of filter

Description

Decode and apply filter instructions to the `skb->data`. Return length to keep, 0 for none. `skb` is the data we are filtering, `filter` is the array of filter instructions, and `len` is the number of filter blocks in the array.

sk_chk_filter

LINUX

Kernel Hackers Manual January 2009

Name

`sk_chk_filter` — verify socket filter code

Synopsis

```
int sk_chk_filter (struct sock_filter * filter, 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.

1.4. Generic Network Statistics

struct gnet_stats_basic

LINUX

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

struct gnet_stats_rate_est

LINUX

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

struct gnet_stats_queue

LINUX

Kernel Hackers Manual January 2009

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

struct gnet_estimator

LINUX

Kernel Hackers Manual January 2009

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

`gnet_stats_start_copy_compat`

LINUX

Kernel Hackers Manual January 2009

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

skb

socket buffer to put statistics TLVs into

type

TLV type for top level statistic TLV

tc_stats_type

TLV type for backward compatibility struct tc_stats TLV

xstats_type

TLV type for backward compatibility xstats 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 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.

gnet_stats_start_copy

LINUX

Kernel Hackers Manual January 2009

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 a container for all other statistic TLVS.

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

gnet_stats_copy_basic

LINUX

Kernel Hackers Manual January 2009

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 * 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.

gnet_stats_copy_rate_est

LINUX

Kernel Hackers Manual January 2009

Name

`gnet_stats_copy_rate_est` — copy rate estimator statistics into statistics TLV

Synopsis

```
int gnet_stats_copy_rate_est (struct gnet_dump * d, struct
gnet_stats_rate_est * r);
```

Arguments

d

dumping handle

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.

gnet_stats_copy_queue

LINUX

Kernel Hackers Manual January 2009

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.

gnet_stats_copy_app

LINUX

Kernel Hackers Manual January 2009

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.

gnet_stats_finish_copy

LINUX

Kernel Hackers Manual January 2009

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.

gen_new_estimator

LINUX

Kernel Hackers Manual January 2009

Name

`gen_new_estimator` — create a new rate estimator

Synopsis

```
int gen_new_estimator (struct gnet_stats_basic * bstats,  
struct gnet_stats_rate_est * rate_est, spinlock_t *  
stats_lock, struct nlattr * opt);
```

Arguments

bstats

basic statistics

rate_est

rate estimator statistics

stats_lock

statistics lock

opt

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.

NOTE

Called under *rtnl_mutex*

gen_kill_estimator

LINUX

Name

`gen_kill_estimator` — remove a rate estimator

Synopsis

```
void gen_kill_estimator (struct gnet_stats_basic * bstats,  
struct gnet_stats_rate_est * rate_est);
```

Arguments

bstats

basic statistics

rate_est

rate estimator statistics

Description

Removes the rate estimator specified by *bstats* and *rate_est* and deletes the timer.

NOTE

Called under `rtnl_mutex`

`gen_replace_estimator`

LINUX

Name

`gen_replace_estimator` — replace rate estimator configuration

Synopsis

```
int gen_replace_estimator (struct gnet_stats_basic * bstats,
struct gnet_stats_rate_est * rate_est, spinlock_t *
stats_lock, struct nlattr * opt);
```

Arguments

bstats

basic statistics

rate_est

rate estimator statistics

stats_lock

statistics lock

opt

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.

1.5. SUN RPC subsystem

xdr_encode_opaque_fixed

LINUX

Kernel Hackers Manual January 2009

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

xdr_encode_opaque

LINUX

Kernel Hackers Manual January 2009

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

xdr_init_encode

LINUX

Kernel Hackers Manual January 2009

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.

xdr_reserve_space

LINUX

Kernel Hackers Manual January 2009

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.

xdr_write_pages

LINUX

Kernel Hackers Manual January 2009

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

xdr_init_decode

LINUX

Kernel Hackers Manual January 2009

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

xdr_inline_decode

LINUX

Name

`xdr_inline_decode` — Retrieve non-page 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.

`xdr_read_pages`

LINUX

Name

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

Synopsis

```
void 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[]`.

`xdr_enter_page`

LINUX

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.

svc_print_addr

LINUX

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

svc_reserve

LINUX

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*.

xprt_register_transport

LINUX

Kernel Hackers Manual January 2009

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

xprt_unregister_transport

LINUX

Kernel Hackers Manual January 2009

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

xprt_reserve_xprt

LINUX

Kernel Hackers Manual January 2009

Name

xprt_reserve_xprt — serialize write access to transports

Synopsis

```
int xprt_reserve_xprt (struct rpc_task * task);
```

Arguments

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.

xprt_release_xprt

LINUX

Kernel Hackers Manual January 2009

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.

xprt_release_xprt_cong

LINUX

Kernel Hackers Manual January 2009

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.

xprt_release_rqst_cong

LINUX

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.

xprt_adjust_cwnd

LINUX

Name

`xprt_adjust_cwnd` — adjust transport congestion window

Synopsis

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

Arguments

task

recently completed RPC request used to adjust window

result

result code of completed RPC request

Description

We use a time-smoothed congestion estimator to avoid heavy oscillation.

xprt_wake_pending_tasks

LINUX

Kernel Hackers Manual January 2009

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

xprt_wait_for_buffer_space

LINUX

Kernel Hackers Manual January 2009

Name

`xprt_wait_for_buffer_space` — wait for transport output buffer to clear

Synopsis

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

Arguments

task

task to be put to sleep

xprt_write_space

LINUX

Kernel Hackers Manual January 2009

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.

xprt_set_retrans_timeout_def

LINUX

Kernel Hackers Manual January 2009

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.

xprt_disconnect_done

LINUX

Kernel Hackers Manual January 2009

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

xprt_force_disconnect

LINUX

Kernel Hackers Manual January 2009

Name

`xprt_force_disconnect` — force a transport to disconnect

Synopsis

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

Arguments

xprt

transport to disconnect

xprt_lookup_rqst

LINUX

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

xprt_update_rtt

LINUX

Name

`xprt_update_rtt` — update an RPC client's RTT state after receiving a reply

Synopsis

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

Arguments

task

RPC request that recently completed

xprt_complete_rqst

LINUX

Kernel Hackers Manual January 2009

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.

rpc_wake_up

LINUX

Kernel Hackers Manual January 2009

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`

rpc_wake_up_status

LINUX

Kernel Hackers Manual January 2009

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`

rpc_malloc

LINUX

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` 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`.

rpc_free

LINUX

Kernel Hackers Manual January 2009

Name

`rpc_free` — free buffer allocated via `rpc_malloc`

Synopsis

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

Arguments

buffer

buffer to free

xdr_skb_read_bits

LINUX

Kernel Hackers Manual January 2009

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.

xdr_partial_copy_from_skb

LINUX

Kernel Hackers Manual January 2009

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

xdr

target XDR buffer

base

starting offset

desc

sk_buff copy helper

copy_actor

virtual method for copying data

csum_partial_copy_to_xdr

LINUX

Kernel Hackers Manual January 2009

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

rpc_alloc_iostats

LINUX

Kernel Hackers Manual January 2009

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

rpc_free_iostats

LINUX

Kernel Hackers Manual January 2009

Name

`rpc_free_iostats` — release an `rpc_iostats` structure

Synopsis

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

Arguments

stats

doomed `rpc_iostats` structure

rpc_queue_upcall

LINUX

Kernel Hackers Manual January 2009

Name

`rpc_queue_upcall` —

Synopsis

```
int rpc_queue_upcall (struct inode * inode, struct
rpc_pipe_msg * msg);
```

Arguments

inode

inode of 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.

rpc_mkpipe

LINUX

Kernel Hackers Manual January 2009

Name

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

Synopsis

```
struct dentry * rpc_mkpipe (struct dentry * parent, const char
* name, void * private, struct rpc_pipe_ops * ops, int flags);
```

Arguments

parent

dentry of directory to create new “pipe” in

name

name of pipe

private

private data to associate with the pipe, for the caller’s use

ops

operations defining the behavior of the pipe: `upcall`, `downcall`, `release_pipe`, and `destroy_msg`.

flags

`rpc_inode` flags

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->f_dentry->d_inode)->private`.

rpc_unlink

LINUX

Kernel Hackers Manual January 2009

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.

rpcb_getport_sync

LINUX

Kernel Hackers Manual January 2009

Name

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

Synopsis

```
int rpcb_getport_sync (struct sockaddr_in * sin, u32 prog, u32  
vers, int prot);
```

Arguments

sin

address of remote peer

prog

RPC program number to bind

vers

RPC version number to bind

prot

transport protocol to use to make this request

Description

Return value is the requested advertised port number, or a negative errno value.

Called from outside the RPC client in a synchronous task context. Uses default timeout parameters specified by underlying transport.

XXX

Needs to support IPv6

rpcb_getport_async

LINUX

Kernel Hackers Manual January 2009

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.

rpc_bind_new_program

LINUX

Kernel Hackers Manual January 2009

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,  
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.

rpc_run_task

LINUX

Kernel Hackers Manual January 2009

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

rpc_call_sync

LINUX

Name

`rpc_call_sync` — Perform a synchronous RPC call

Synopsis

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

Arguments

clnt

pointer to RPC client

msg

RPC call parameters

flags

RPC call flags

rpc_call_async

LINUX

Name

`rpc_call_async` — Perform an asynchronous RPC call

Synopsis

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

Arguments

clnt

pointer to RPC client

msg

RPC call parameters

flags

RPC call flags

tk_ops

RPC call ops

data

user call data

rpc_peeraddr

LINUX

Kernel Hackers Manual January 2009

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

clnt

RPC client structure

buf

target buffer

bufsize

length of target buffer

Description

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

rpc_peeraddr2str

LINUX

Kernel Hackers Manual January 2009

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

rpc_force_rebind

LINUX

Kernel Hackers Manual January 2009

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

Chapter 2. Network device support

2.1. Driver Support

dev_add_pack

LINUX

Kernel Hackers Manual January 2009

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).

__dev_remove_pack

LINUX

Kernel Hackers Manual January 2009

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.

dev_remove_pack

LINUX

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.

netdev_boot_setup_check

LINUX

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.

__dev_get_by_name

LINUX

Kernel Hackers Manual January 2009

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.

dev_get_by_name

LINUX

Kernel Hackers Manual January 2009

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.

__dev_get_by_index

LINUX

Kernel Hackers Manual January 2009

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*.

dev_get_by_index

LINUX

Kernel Hackers Manual January 2009

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.

dev_getbyhwaddr

LINUX

Kernel Hackers Manual January 2009

Name

`dev_getbyhwaddr` — find a device by its hardware address

Synopsis

```
struct net_device * dev_getbyhwaddr (struct net * net,  
unsigned short type, 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 the rtnl semaphore. The returned device has not had its ref count increased and the caller must therefore be careful about locking

BUGS

If the API was consistent this would be `__dev_get_by_hwaddr`

dev_get_by_flags

LINUX

Kernel Hackers Manual January 2009

Name

`dev_get_by_flags` — find any device with given flags

Synopsis

```
struct net_device * dev_get_by_flags (struct net * net,  
unsigned short if_flags, unsigned short mask);
```

Arguments

net

the applicable net namespace

if_flags

IFF_* values

mask

bitmask of bits in *if_flags* 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. 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.

dev_valid_name

LINUX

Kernel Hackers Manual January 2009

Name

`dev_valid_name` — check if name is okay for network device

Synopsis

```
int 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.

dev_alloc_name

LINUX

Kernel Hackers Manual January 2009

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 “%ld” 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.

netdev_features_change

LINUX

Kernel Hackers Manual January 2009

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.

netdev_state_change

LINUX

Kernel Hackers Manual January 2009

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.

dev_load

LINUX

Kernel Hackers Manual January 2009

Name

`dev_load` — load a network module

Synopsis

```
void dev_load (struct net * net, const char * name);
```

Arguments

net

the applicable net namespace

name

name of interface

Description

If a network interface is not present and the process has suitable privileges this function loads the module. If module loading is not available in this kernel then it becomes a nop.

dev_open

LINUX

Kernel Hackers Manual January 2009

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.

dev_close

LINUX

Kernel Hackers Manual January 2009

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.

register_netdevice_notifier

LINUX

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.

unregister_netdevice_notifier

LINUX

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.

netif_device_detach

LINUX

Kernel Hackers Manual January 2009

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.

netif_device_attach

LINUX

Kernel Hackers Manual January 2009

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.

skb_gso_segment

LINUX

Kernel Hackers Manual January 2009

Name

`skb_gso_segment` — Perform segmentation on `skb`.

Synopsis

```
struct sk_buff * skb_gso_segment (struct sk_buff * skb, int
features);
```

Arguments

skb

buffer to segment

features

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

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.

dev_queue_xmit

LINUX

Kernel Hackers Manual January 2009

Name

`dev_queue_xmit` — transmit a buffer

Synopsis

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

Arguments

skb

buffer to transmit

Description

Queue a buffer for transmission to a network device. The caller must have set the device and priority and built the buffer before calling this function. The function can be called from an interrupt.

A negative errno code is returned on a failure. A success does not guarantee the frame will be transmitted as it may be dropped due to congestion or traffic shaping.

----- I notice this method can also return errors from the queue disciplines, including NET_XMIT_DROP, which is a positive value. So, errors can also be positive.

Regardless of the return value, the skb is consumed, so it is currently difficult to retry a send to this method. (You can bump the ref count before sending to hold a reference for retry if you are careful.)

When calling this method, interrupts MUST be enabled. This is because the BH enable code must have IRQs enabled so that it will not deadlock. --BLG

netif_rx

LINUX

Kernel Hackers Manual January 2009

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)

netif_receive_skb

LINUX

Kernel Hackers Manual January 2009

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

__napi_schedule

LINUX

Kernel Hackers Manual January 2009

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

register_gifconf

LINUX

Kernel Hackers Manual January 2009

Name

register_gifconf — register a SIOCGIF handler

Synopsis

```
int register_gifconf (unsigned int family, gifconf_func_t *  
gifconf);
```

Arguments

family

Address family

gifconf

Function handler

Description

Register protocol dependent address dumping routines. The handler that is passed must not be freed or reused until it has been replaced by another handler.

netdev_set_master

LINUX

Name

`netdev_set_master` — set up master/slave pair

Synopsis

```
int netdev_set_master (struct net_device * slave, struct
net_device * master);
```

Arguments

slave

slave device

master

new master device

Description

Changes the master device of the slave. Pass `NULL` to break the bonding. The caller must hold the RTNL semaphore. On a failure a negative `errno` code is returned. On success the reference counts are adjusted, `RTM_NEWLINK` is sent to the routing socket and the function returns zero.

`dev_set_promiscuity`

LINUX

Name

`dev_set_promiscuity` — update promiscuity count on a device

Synopsis

```
void 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.

`dev_set_allmulti`

LINUX

Name

`dev_set_allmulti` — update allmulti count on a device

Synopsis

```
void 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.

`dev_unicast_delete`

LINUX

Name

`dev_unicast_delete` — Release secondary unicast address.

Synopsis

```
int dev_unicast_delete (struct net_device * dev, void * addr,
int alen);
```

Arguments

dev

device

addr

address to delete

alen

length of *addr*

Description

Release reference to a secondary unicast address and remove it from the device if the reference count drops to zero.

The caller must hold the `rtnl_mutex`.

`dev_unicast_add`

LINUX

Name

`dev_unicast_add` — add a secondary unicast address

Synopsis

```
int dev_unicast_add (struct net_device * dev, void * addr, int  
alen);
```

Arguments

dev

device

addr

address to delete

alen

length of *addr*

Description

Add a secondary unicast address to the device or increase the reference count if it already exists.

The caller must hold the `rtnl_mutex`.

`dev_unicast_sync`

LINUX

Name

`dev_unicast_sync` — Synchronize device's unicast list to another device

Synopsis

```
int dev_unicast_sync (struct net_device * to, struct  
net_device * from);
```

Arguments

to

destination device

from

source device

Description

Add newly added addresses to the destination device and release addresses that have no users left. The source device must be locked by `netif_tx_lock_bh`.

This function is intended to be called from the `dev->set_rx_mode` function of layered software devices.

`dev_unicast_unsync`

LINUX

Name

`dev_unicast_unsync` — Remove synchronized addresses from the destination device

Synopsis

```
void dev_unicast_unsync (struct net_device * to, struct  
net_device * from);
```

Arguments

to

destination device

from

source device

Description

Remove all addresses that were added to the destination device by `dev_unicast_sync`. This function is intended to be called from the `dev->stop` function of layered software devices.

register_netdevice

LINUX

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.

register_netdev

LINUX

Kernel Hackers Manual January 2009

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`.

alloc_netdev_mq

LINUX

Name

`alloc_netdev_mq` — allocate network device

Synopsis

```
struct net_device * alloc_netdev_mq (int sizeof_priv, const  
char * name, void (*setup) (struct net_device *), unsigned int  
queue_count);
```

Arguments

sizeof_priv

size of private data to allocate space for

name

device name format string

setup

callback to initialize device

queue_count

the number of 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 at the end of the netdevice.

free_netdev

LINUX

Kernel Hackers Manual January 2009

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.

unregister_netdevice

LINUX

Name

`unregister_netdevice` — remove device from the kernel

Synopsis

```
void unregister_netdevice (struct net_device * dev);
```

Arguments

dev

device

Description

This function shuts down a device interface and removes it from the kernel tables.

Callers must hold the `rtnl` semaphore. You may want `unregister_netdev` instead of this.

unregister_netdev

LINUX

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`.

netdev_compute_features

LINUX

Kernel Hackers Manual January 2009

Name

`netdev_compute_features` — compute conjunction of two feature sets

Synopsis

```
int netdev_compute_features (unsigned long all, unsigned long  
one);
```


Arguments

all

first feature set

one

second 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*. Returns the new feature set.

eth_header

LINUX

Kernel Hackers Manual January 2009

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 len);
```

Arguments

skb

buffer to alter

dev

source device

type

Ethernet type field

daddr

destination address (NULL leave destination address)

saddr

source address (NULL use device source address)

len

packet length ($\leq \text{skb->len}$)

Description

Set the protocol type. For a packet of type `ETH_P_802_3` we put the length in here instead. It is up to the 802.2 layer to carry protocol information.

eth_rebuild_header

LINUX

Kernel Hackers Manual January 2009

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.

eth_type_trans

LINUX

Kernel Hackers Manual January 2009

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.

eth_header_parse

LINUX

Kernel Hackers Manual January 2009

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

eth_header_cache

LINUX

Kernel Hackers Manual January 2009

Name

`eth_header_cache` — fill cache entry from neighbour

Synopsis

```
int eth_header_cache (const struct neighbour * neigh, struct  
hh_cache * hh);
```

Arguments

neigh

source neighbour

hh

destination cache entry Create an Ethernet header template from the neighbour.

eth_header_cache_update

LINUX

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.

ether_setup

LINUX

Name

`ether_setup` — setup Ethernet network device

Synopsis

```
void ether_setup (struct net_device * dev);
```

Arguments

dev

network device Fill in the fields of the device structure with Ethernet-generic values.

alloc_etherdev_mq

LINUX

Name

`alloc_etherdev_mq` — Allocates and sets up an Ethernet device

Synopsis

```
struct net_device * alloc_etherdev_mq (int sizeof_priv,  
unsigned int queue_count);
```

Arguments

sizeof_priv

Size of additional driver-private structure to be allocated for this Ethernet device

queue_count

The number of 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.

netif_carrier_on

LINUX

Kernel Hackers Manual January 2009

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.

netif_carrier_off

LINUX

Kernel Hackers Manual January 2009

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.

is_zero_ether_addr

LINUX

Kernel Hackers Manual January 2009

Name

`is_zero_ether_addr` — Determine if give Ethernet address is all zeros.

Synopsis

```
int 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.

is_multicast_ether_addr

LINUX

Name

`is_multicast_ether_addr` — Determine if the Ethernet address is a multicast.

Synopsis

```
int 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.

is_local_ether_addr

LINUX

Name

`is_local_ether_addr` — Determine if the Ethernet address is locally-assigned one (IEEE 802).

Synopsis

```
int 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.

is_broadcast_ether_addr

LINUX

Kernel Hackers Manual January 2009

Name

`is_broadcast_ether_addr` — Determine if the Ethernet address is broadcast

Synopsis

```
int 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.

is_valid_ether_addr

LINUX

Kernel Hackers Manual January 2009

Name

`is_valid_ether_addr` — Determine if the given Ethernet address is valid

Synopsis

```
int 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.

random_ether_addr

LINUX

Kernel Hackers Manual January 2009

Name

`random_ether_addr` — Generate software assigned random Ethernet address

Synopsis

```
void random_ether_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.

compare_ether_addr

LINUX

Kernel Hackers Manual January 2009

Name

`compare_ether_addr` — Compare two Ethernet addresses

Synopsis

```
unsigned compare_ether_addr (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 0 if equal

napi_schedule_prep

LINUX

Name

`napi_schedule_prep` — check if napi can be scheduled

Synopsis

```
int 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.

napi_schedule

LINUX

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.

__napi_complete

LINUX

Kernel Hackers Manual January 2009

Name

__napi_complete — NAPI processing complete

Synopsis

```
void __napi_complete (struct napi_struct * n);
```

Arguments

n

napi context

Description

Mark NAPI processing as complete.

napi_disable

LINUX

Kernel Hackers Manual January 2009

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.

napi_enable

LINUX

Kernel Hackers Manual January 2009

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`.

napi_synchronize

LINUX

Kernel Hackers Manual January 2009

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.

netdev_priv

LINUX

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

netif_napi_add

LINUX

Name

`netif_napi_add` — initialize a napi context

Synopsis

```
void netif_napi_add (struct net_device * dev, struct  
napi_struct * napi, int (*poll) (struct napi_struct *, int),  
int weight);
```

Arguments

dev

network device

napi

napi context

poll

polling function

weight

default weight

Description

`netif_napi_add` must be used to initialize a napi context prior to calling *any* of the other napi related functions.

netif_start_queue

LINUX

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.

netif_wake_queue

LINUX

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.

netif_stop_queue

LINUX

Kernel Hackers Manual January 2009

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.

netif_queue_stopped

LINUX

Kernel Hackers Manual January 2009

Name

`netif_queue_stopped` — test if transmit queue is flowblocked

Synopsis

```
int netif_queue_stopped (const struct net_device * dev);
```

Arguments

dev

network device

Description

Test if transmit queue on device is currently unable to send.

netif_running

LINUX

Kernel Hackers Manual January 2009

Name

`netif_running` — test if up

Synopsis

```
int netif_running (const struct net_device * dev);
```

Arguments

dev

network device

Description

Test if the device has been brought up.

netif_start_subqueue

LINUX

Kernel Hackers Manual January 2009

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.

netif_stop_subqueue

LINUX

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.

__netif_subqueue_stopped

LINUX

Name

`__netif_subqueue_stopped` — test status of subqueue

Synopsis

```
int __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.

netif_wake_subqueue

LINUX

Kernel Hackers Manual January 2009

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.

netif_is_multiqueue

LINUX

Kernel Hackers Manual January 2009

Name

`netif_is_multiqueue` — test if device has multiple transmit queues

Synopsis

```
int netif_is_multiqueue (const struct net_device * dev);
```

Arguments

dev

network device

Description

Check if device has multiple transmit queues Always falls if
NETDEVICE_MULTIQUEUE is not configured

dev_put

LINUX

Kernel Hackers Manual January 2009

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.

dev_hold

LINUX

Kernel Hackers Manual January 2009

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.

netif_carrier_ok

LINUX

Kernel Hackers Manual January 2009

Name

`netif_carrier_ok` — test if carrier present

Synopsis

```
int netif_carrier_ok (const struct net_device * dev);
```

Arguments

dev

network device

Description

Check if carrier is present on device

netif_dormant_on

LINUX

Kernel Hackers Manual January 2009

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.

netif_dormant_off

LINUX

Kernel Hackers Manual January 2009

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.

netif_dormant

LINUX

Kernel Hackers Manual January 2009

Name

`netif_dormant` — test if carrier present

Synopsis

```
int netif_dormant (const struct net_device * dev);
```

Arguments

dev

network device

Description

Check if carrier is present on device

netif_oper_up

LINUX

Kernel Hackers Manual January 2009

Name

`netif_oper_up` — test if device is operational

Synopsis

```
int netif_oper_up (const struct net_device * dev);
```

Arguments

dev

network device

Description

Check if carrier is operational

netif_device_present

LINUX

Name

`netif_device_present` — is device available or removed

Synopsis

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

Arguments

dev

network device

Description

Check if device has not been removed from system.

__netif_tx_lock

LINUX

Name

`__netif_tx_lock` — grab network device transmit lock

Synopsis

```
void __netif_tx_lock (struct net_device * dev, int cpu);
```

Arguments

dev

network device

cpu

cpu number of lock owner

Description

Get network device transmit lock

2.2. PHY Support

phy_print_status

LINUX

Kernel Hackers Manual January 2009

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

phy_read

LINUX

Kernel Hackers Manual January 2009

Name

`phy_read` — Convenience function for reading a given PHY register

Synopsis

```
int phy_read (struct phy_device * phydev, u16 regnum);
```

Arguments

phydev

the `phy_device` struct

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.

phy_write

LINUX

Kernel Hackers Manual January 2009

Name

`phy_write` — Convenience function for writing a given PHY register

Synopsis

```
int phy_write (struct phy_device * phydev, u16 regnum, u16  
val);
```

Arguments

phydev

the `phy_device` struct

regnum

register number to write

val

value to write to *regnum*

NOTE

MUST NOT be called from interrupt context, because the bus read/write functions may wait for an interrupt to conclude the operation.

phy_sanitize_settings

LINUX

Kernel Hackers Manual January 2009

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.

phy_ethtool_sset

LINUX

Kernel Hackers Manual January 2009

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.

phy_mii_ioctl

LINUX

Kernel Hackers Manual January 2009

Name

`phy_mii_ioctl` — generic PHY MII ioctl interface

Synopsis

```
int phy_mii_ioctl (struct phy_device * phydev, struct  
mii_ioctl_data * mii_data, int cmd);
```

Arguments

phydev

the `phy_device` struct

mii_data

MII ioctl data

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.

phy_start_aneg

LINUX

Kernel Hackers Manual January 2009

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.

phy_enable_interrupts

LINUX

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

phy_disable_interrupts

LINUX

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

phy_start_interrupts

LINUX

Kernel Hackers Manual January 2009

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.

phy_stop_interrupts

LINUX

Kernel Hackers Manual January 2009

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

phy_stop

LINUX

Kernel Hackers Manual January 2009

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

phy_start

LINUX

Kernel Hackers Manual January 2009

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.

phy_clear_interrupt

LINUX

Kernel Hackers Manual January 2009

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.

phy_config_interrupt

LINUX

Kernel Hackers Manual January 2009

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 on < 0 on error.

phy_aneg_done

LINUX

Name

`phy_aneg_done` — return auto-negotiation status

Synopsis

```
int phy_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.

phy_find_setting

LINUX

Name

`phy_find_setting` — find a PHY settings array entry that matches speed & duplex

Synopsis

```
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.

phy_find_valid

LINUX

Kernel Hackers Manual January 2009

Name

`phy_find_valid` — find a PHY setting that matches the requested features mask

Synopsis

```
int phy_find_valid (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.

phy_start_machine

LINUX

Kernel Hackers Manual January 2009

Name

`phy_start_machine` — start PHY state machine tracking

Synopsis

```
void phy_start_machine (struct phy_device * phydev, void
(*handler) (struct net_device *));
```

Arguments

phydev

the `phy_device` struct

handler

callback function for state change notifications

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 be notified when the state changes, pass in the callback *handler*, otherwise, pass `NULL`. If you want to maintain your own state machine, do not call this function.

phy_stop_machine

LINUX

Kernel Hackers Manual January 2009

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.

phy_force_reduction

LINUX

Kernel Hackers Manual January 2009

Name

`phy_force_reduction` — reduce PHY speed/duplex settings by one step

Synopsis

```
void phy_force_reduction (struct phy_device * phydev);
```

Arguments

phydev

target phy_device struct

Description

Reduces the speed/duplex settings by one notch, in this order-- 1000/FULL, 1000/HALF, 100/FULL, 100/HALF, 10/FULL, 10/HALF. The function bottoms out at 10/HALF.

phy_error

LINUX

Kernel Hackers Manual January 2009

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.

phy_interrupt

LINUX

Kernel Hackers Manual January 2009

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.

phy_change

LINUX

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

phy_state_machine

LINUX

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

Description

Scheduled by the state_queue workqueue each time phy_timer is triggered.

phy_connect

LINUX

Kernel Hackers Manual January 2009

Name

phy_connect — connect an ethernet device to a PHY device

Synopsis

```
struct phy_device * phy_connect (struct net_device * dev,  
const char * phy_id, void (*handler) (struct net_device *),  
u32 flags, phy_interface_t interface);
```

Arguments

dev

the network device to connect

phy_id

the PHY device to connect

handler

callback function for state change notifications

flags

PHY device's dev_flags

interface

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.

phy_disconnect

LINUX

Kernel Hackers Manual January 2009

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

phy_attach

LINUX

Kernel Hackers Manual January 2009

Name

`phy_attach` — attach a network device to a particular PHY device

Synopsis

```
struct phy_device * phy_attach (struct net_device * dev, const  
char * phy_id, u32 flags, phy_interface_t interface);
```

Arguments

dev

network device to attach

phy_id

PHY device to attach

flags

PHY device's dev_flags

interface

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 the `genphy_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.

phy_detach

LINUX

Kernel Hackers Manual January 2009

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

genphy_config_advert

LINUX

Kernel Hackers Manual January 2009

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.

genphy_config_aneg

LINUX

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.

genphy_update_link

LINUX

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.

genphy_read_status

LINUX

Kernel Hackers Manual January 2009

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.

phy_driver_register

LINUX

Kernel Hackers Manual January 2009

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

get_phy_device

LINUX

Kernel Hackers Manual January 2009

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);
```

Arguments

bus

the target MII bus

addr

PHY address on the MII bus

Description

Reads the ID registers of the PHY at *addr* on the *bus*, then allocates and returns the `phy_device` to represent it.

phy_prepare_link

LINUX

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.

`genphy_setup_forced`

LINUX

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`.

genphy_restart_aneg

LINUX

Name

`genphy_restart_aneg` — Enable and Restart Autonegotiation

Synopsis

```
int genphy_restart_aneg (struct phy_device * phydev);
```

Arguments

phydev

target phy_device struct

phy_probe

LINUX

Kernel Hackers Manual January 2009

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).

mdiobus_register

LINUX

Kernel Hackers Manual January 2009

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.

mdio_bus_match

LINUX

Kernel Hackers Manual January 2009

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.

2.3. Synchronous PPP

sppp_close

LINUX

Kernel Hackers Manual January 2009

Name

`sppp_close` — close down a synchronous PPP or Cisco HDLC link

Synopsis

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

Arguments

dev

The network device to drop the link of

Description

This drops the logical interface to the channel. It is not done politely as we assume we will also be dropping DTR. Any timeouts are killed.

sppp_open

LINUX

Name

`sppp_open` — open a synchronous PPP or Cisco HDLC link

Synopsis

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

Arguments

dev

Network device to activate

Description

Close down any existing synchronous session and commence from scratch. In the PPP case this means negotiating LCP/IPCPC and friends, while for Cisco HDLC we simply need to start sending keepalives

sppp_reopen

LINUX

Name

`sppp_reopen` — notify of physical link loss

Synopsis

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

Arguments

dev

Device that lost the link

Description

This function informs the synchronous protocol code that the underlying link died (for example a carrier drop on X.21)

We increment the magic numbers to ensure that if the other end failed to notice we will correctly start a new session. It happens do to the nature of telco circuits is that you can lose carrier on one end only.

Having done this we go back to negotiating. This function may be called from an interrupt context.

sppp_do_ioctl

LINUX

Kernel Hackers Manual January 2009

Name

sppp_do_ioctl — Ioctl handler for ppp/hdlc

Synopsis

```
int sppp_do_ioctl (struct net_device * dev, struct ifreq *  
ifr, int cmd);
```

Arguments

dev

Device subject to ioctl

ifr

Interface request block from the user

cmd

Command that is being issued

Description

This function handles the ioctls that may be issued by the user to control the settings of a PPP/HDLC link. It does both busy and security checks. This function is intended to be wrapped by callers who wish to add additional ioctl calls of their own.

sppp_attach

LINUX

Kernel Hackers Manual January 2009

Name

`sppp_attach` — attach synchronous PPP/HDLC to a device

Synopsis

```
void sppp_attach (struct ppp_device * pd);
```

Arguments

pd

PPP device to initialise

Description

This initialises the PPP/HDLC support on an interface. At the time of calling the `dev` element must point to the network device that this interface is attached to. The interface should not yet be registered.

sppp_detach

LINUX

Kernel Hackers Manual January 2009

Name

`sppp_detach` — release PPP resources from a device

Synopsis

```
void sppp_detach (struct net_device * dev);
```

Arguments

dev

Network device to release

Description

Stop and free up any PPP/HDLC resources used by this interface. This must be called before the device is freed.