

# **RapidIO Subsystem Guide**

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# **RapidIO Subsystem Guide**

by Matt Porter

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# Chapter 1. Introduction

RapidIO is a high speed switched fabric interconnect with features aimed at the embedded market. RapidIO provides support for memory-mapped I/O as well as message-based transactions over the switched fabric network. RapidIO has a standardized discovery mechanism not unlike the PCI bus standard that allows simple detection of devices in a network.

This documentation is provided for developers intending to support RapidIO on new architectures, write new drivers, or to understand the subsystem internals.





# Chapter 2. Known Bugs and Limitations

## 2.1. Bugs

None. ;)

## 2.2. Limitations

1. Access/management of RapidIO memory regions is not supported
2. Multiple host enumeration is not supported



# Chapter 3. RapidIO driver interface

Drivers are provided a set of calls in order to interface with the subsystem to gather info on devices, request/map memory region resources, and manage mailboxes/doorbells.

## 3.1. Functions

### rio\_local\_read\_config\_32

**LINUX**

Kernel Hackers Manual September 2014

#### Name

`rio_local_read_config_32` — Read 32 bits from local configuration space

#### Synopsis

```
int rio_local_read_config_32 (struct rio_mport * port, u32
offset, u32 * data);
```

#### Arguments

*port*

Master port

*offset*

Offset into local configuration space

*data*

Pointer to read data into

## Description

Reads 32 bits of data from the specified offset within the local device's configuration space.

# rio\_local\_write\_config\_32

## LINUX

Kernel Hackers ManualSeptember 2014

## Name

`rio_local_write_config_32` — Write 32 bits to local configuration space

## Synopsis

```
int rio_local_write_config_32 (struct rio_mport * port, u32
offset, u32 data);
```

## Arguments

*port*

Master port

*offset*

Offset into local configuration space

*data*

Data to be written

## Description

Writes 32 bits of data to the specified offset within the local device's configuration space.

# rio\_local\_read\_config\_16

## LINUX

Kernel Hackers ManualSeptember 2014

## Name

`rio_local_read_config_16` — Read 16 bits from local configuration space

## Synopsis

```
int rio_local_read_config_16 (struct rio_mport * port, u32
offset, u16 * data);
```

## Arguments

*port*

Master port

*offset*

Offset into local configuration space

*data*

Pointer to read data into

## Description

Reads 16 bits of data from the specified offset within the local device's configuration space.

# rio\_local\_write\_config\_16

## LINUX

Kernel Hackers ManualSeptember 2014

## Name

`rio_local_write_config_16` — Write 16 bits to local configuration space

## Synopsis

```
int rio_local_write_config_16 (struct rio_mport * port, u32
offset, u16 data);
```

## Arguments

*port*

Master port

*offset*

Offset into local configuration space

*data*

Data to be written

## Description

Writes 16 bits of data to the specified offset within the local device's configuration space.

# rio\_local\_read\_config\_8

## LINUX

Kernel Hackers ManualSeptember 2014

## Name

`rio_local_read_config_8` — Read 8 bits from local configuration space

## Synopsis

```
int rio_local_read_config_8 (struct rio_mport * port, u32
offset, u8 * data);
```

## Arguments

*port*

Master port

*offset*

Offset into local configuration space

*data*

Pointer to read data into

## Description

Reads 8 bits of data from the specified offset within the local device's configuration space.

# rio\_local\_write\_config\_8

## LINUX

Kernel Hackers ManualSeptember 2014

## Name

`rio_local_write_config_8` — Write 8 bits to local configuration space

## Synopsis

```
int rio_local_write_config_8 (struct rio_mport * port, u32
offset, u8 data);
```

## Arguments

*port*

Master port

*offset*

Offset into local configuration space

*data*

Data to be written



## Description

Writes 8 bits of data to the specified offset within the local device's configuration space.

# rio\_read\_config\_32

## LINUX

Kernel Hackers ManualSeptember 2014

## Name

`rio_read_config_32` — Read 32 bits from configuration space

## Synopsis

```
int rio_read_config_32 (struct rio_dev * rdev, u32 offset, u32  
* data);
```

## Arguments

*rdev*

RIO device

*offset*

Offset into device configuration space

*data*

Pointer to read data into

## Description

Reads 32 bits of data from the specified offset within the RIO device's configuration space.

# rio\_write\_config\_32

## LINUX

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## Name

`rio_write_config_32` — Write 32 bits to configuration space

## Synopsis

```
int rio_write_config_32 (struct rio_dev * rdev, u32 offset,
u32 data);
```

## Arguments

*rdev*

RIO device

*offset*

Offset into device configuration space

*data*

Data to be written

## Description

Writes 32 bits of data to the specified offset within the RIO device's configuration space.

# rio\_read\_config\_16

## LINUX

Kernel Hackers ManualSeptember 2014

## Name

`rio_read_config_16` — Read 16 bits from configuration space

## Synopsis

```
int rio_read_config_16 (struct rio_dev * rdev, u32 offset, u16  
* data);
```

## Arguments

*rdev*

RIO device

*offset*

Offset into device configuration space

*data*

Pointer to read data into

## Description

Reads 16 bits of data from the specified offset within the RIO device's configuration space.

# rio\_write\_config\_16

## LINUX

Kernel Hackers ManualSeptember 2014

## Name

`rio_write_config_16` — Write 16 bits to configuration space

## Synopsis

```
int rio_write_config_16 (struct rio_dev * rdev, u32 offset,
u16 data);
```

## Arguments

*rdev*

RIO device

*offset*

Offset into device configuration space

*data*

Data to be written

## Description

Writes 16 bits of data to the specified offset within the RIO device's configuration space.

# rio\_read\_config\_8

## LINUX

Kernel Hackers ManualSeptember 2014

## Name

`rio_read_config_8` — Read 8 bits from configuration space

## Synopsis

```
int rio_read_config_8 (struct rio_dev * rdev, u32 offset, u8 * data);
```

## Arguments

*rdev*

RIO device

*offset*

Offset into device configuration space

*data*

Pointer to read data into

## Description

Reads 8 bits of data from the specified offset within the RIO device's configuration space.

# rio\_write\_config\_8

## LINUX

Kernel Hackers ManualSeptember 2014

## Name

`rio_write_config_8` — Write 8 bits to configuration space

## Synopsis

```
int rio_write_config_8 (struct rio_dev * rdev, u32 offset, u8 data);
```

## Arguments

*rdev*

RIO device

*offset*

Offset into device configuration space

*data*

Data to be written

## Description

Writes 8 bits of data to the specified offset within the RIO device's configuration space.

# rio\_send\_doorbell

## LINUX

Kernel Hackers ManualSeptember 2014

## Name

`rio_send_doorbell` — Send a doorbell message to a device

## Synopsis

```
int rio_send_doorbell (struct rio_dev * rdev, u16 data);
```

## Arguments

*rdev*

RIO device

*data*

Doorbell message data

## Description

Send a doorbell message to a RIO device. The doorbell message has a 16-bit info field provided by the *data* argument.

# rio\_init\_mbox\_res

## LINUX

Kernel Hackers ManualSeptember 2014

### Name

`rio_init_mbox_res` — Initialize a RIO mailbox resource

### Synopsis

```
void rio_init_mbox_res (struct resource * res, int start, int  
end);
```

### Arguments

*res*

resource struct

*start*

start of mailbox range

*end*

end of mailbox range

### Description

This function is used to initialize the fields of a resource for use as a mailbox resource. It initializes a range of mailboxes using the start and end arguments.



# rio\_init\_dbell\_res

## LINUX

Kernel Hackers ManualSeptember 2014

### Name

`rio_init_dbell_res` — Initialize a RIO doorbell resource

### Synopsis

```
void rio_init_dbell_res (struct resource * res, u16 start, u16  
end);
```

### Arguments

*res*

resource struct

*start*

start of doorbell range

*end*

end of doorbell range

### Description

This function is used to initialize the fields of a resource for use as a doorbell resource. It initializes a range of doorbell messages using the start and end arguments.

# RIO\_DEVICE

## LINUX

Kernel Hackers ManualSeptember 2014

### Name

RIO\_DEVICE — macro used to describe a specific RIO device

### Synopsis

```
RIO_DEVICE ( dev, ven );
```

### Arguments

*dev*

the 16 bit RIO device ID

*ven*

the 16 bit RIO vendor ID

### Description

This macro is used to create a struct `rio_device_id` that matches a specific device. The assembly vendor and assembly device fields will be set to `RIO_ANY_ID`.

## rio\_add\_outb\_message

## LINUX

## Name

`rio_add_outb_message` — Add RIO message to an outbound mailbox queue

## Synopsis

```
int rio_add_outb_message (struct rio_mport * mport, struct
rio_dev * rdev, int mbox, void * buffer, size_t len);
```

## Arguments

*mport*

RIO master port containing the outbound queue

*rdev*

RIO device the message is be sent to

*mbox*

The outbound mailbox queue

*buffer*

Pointer to the message buffer

*len*

Length of the message buffer

## Description

Adds a RIO message buffer to an outbound mailbox queue for transmission.  
Returns 0 on success.

# rio\_add\_inb\_buffer

## LINUX

Kernel Hackers ManualSeptember 2014

### Name

`rio_add_inb_buffer` — Add buffer to an inbound mailbox queue

### Synopsis

```
int rio_add_inb_buffer (struct rio_mport * mport, int mbox,  
void * buffer);
```

### Arguments

*mport*

Master port containing the inbound mailbox

*mbox*

The inbound mailbox number

*buffer*

Pointer to the message buffer

### Description

Adds a buffer to an inbound mailbox queue for reception. Returns 0 on success.

# rio\_get\_inb\_message

## LINUX

Kernel Hackers ManualSeptember 2014

### Name

`rio_get_inb_message` — Get A RIO message from an inbound mailbox queue

### Synopsis

```
void * rio_get_inb_message (struct rio_mport * mport, int mbox);
```

### Arguments

*mport*

Master port containing the inbound mailbox

*mbox*

The inbound mailbox number

### Description

Get a RIO message from an inbound mailbox queue. Returns 0 on success.

# rio\_name

## LINUX

## Name

`rio_name` — Get the unique RIO device identifier

## Synopsis

```
const char * rio_name (struct rio_dev * rdev);
```

## Arguments

*rdev*

RIO device

## Description

Get the unique RIO device identifier. Returns the device identifier string.

# rio\_get\_drvdata

## LINUX

## Name

`rio_get_drvdata` — Get RIO driver specific data

## Synopsis

```
void * rio_get_drvdata (struct rio_dev * rdev);
```

## Arguments

*rdev*

RIO device

## Description

Get RIO driver specific data. Returns a pointer to the driver specific data.

## rio\_set\_drvdata

### LINUX

Kernel Hackers ManualSeptember 2014

## Name

`rio_set_drvdata` — Set RIO driver specific data

## Synopsis

```
void rio_set_drvdata (struct rio_dev * rdev, void * data);
```

## Arguments

*rdev*

RIO device

*data*

Pointer to driver specific data

## Description

Set RIO driver specific data. device struct driver data pointer is set to the *data* argument.

## rio\_dev\_get

### LINUX

Kernel Hackers ManualSeptember 2014

## Name

`rio_dev_get` — Increments the reference count of the RIO device structure

## Synopsis

```
struct rio_dev * rio_dev_get (struct rio_dev * rdev);
```

## Arguments

*rdev*

RIO device being referenced



## Description

Each live reference to a device should be refcounted.

Drivers for RIO devices should normally record such references in their `probe` methods, when they bind to a device, and release them by calling `rio_dev_put`, in their `disconnect` methods.

# rio\_dev\_put

## LINUX

Kernel Hackers ManualSeptember 2014

## Name

`rio_dev_put` — Release a use of the RIO device structure

## Synopsis

```
void rio_dev_put (struct rio_dev * rdev);
```

## Arguments

*rdev*

RIO device being disconnected

## Description

Must be called when a user of a device is finished with it. When the last user of the device calls this function, the memory of the device is freed.

# rio\_register\_driver

## LINUX

Kernel Hackers ManualSeptember 2014

### Name

`rio_register_driver` — register a new RIO driver

### Synopsis

```
int rio_register_driver (struct rio_driver * rdrv);
```

### Arguments

*rdrv*

the RIO driver structure to register

### Description

Adds a struct `rio_driver` to the list of registered drivers. Returns a negative value on error, otherwise 0. If no error occurred, the driver remains registered even if no device was claimed during registration.

# rio\_unregister\_driver

## LINUX

## Name

`rio_unregister_driver` — unregister a RIO driver

## Synopsis

```
void rio_unregister_driver (struct rio_driver * rdrv);
```

## Arguments

*rdrv*

the RIO driver structure to unregister

## Description

Deletes the struct `rio_driver` from the list of registered RIO drivers, gives it a chance to clean up by calling its `remove` function for each device it was responsible for, and marks those devices as driverless.

# rio\_local\_get\_device\_id

## LINUX

## Name

`rio_local_get_device_id` — Get the base/extended device id for a port

## Synopsis

```
ul6 rio_local_get_device_id (struct rio_mport * port);
```

## Arguments

*port*

RIO master port from which to get the deviceid

## Description

Reads the base/extended device id from the local device implementing the master port. Returns the 8/16-bit device id.

# rio\_request\_inb\_mbox

## LINUX

Kernel Hackers ManualSeptember 2014

## Name

`rio_request_inb_mbox` — request inbound mailbox service

## Synopsis

```
int rio_request_inb_mbox (struct rio_mport * mport, void *  
dev_id, int mbox, int entries, void (*minb) (struct rio_mport  
* mport, void *dev_id, int mbox, int slot));
```

## Arguments

*mport*

RIO master port from which to allocate the mailbox resource

*dev\_id*

Device specific pointer to pass on event

*mbox*

Mailbox number to claim

*entries*

Number of entries in inbound mailbox queue

*minb*

Callback to execute when inbound message is received

## Description

Requests ownership of an inbound mailbox resource and binds a callback function to the resource. Returns 0 on success.

# rio\_release\_inb\_mbox

## LINUX

Kernel Hackers ManualSeptember 2014

## Name

`rio_release_inb_mbox` — release inbound mailbox message service

## Synopsis

```
int rio_release_inb_mbox (struct rio_mport * mport, int mbox);
```

## Arguments

*mport*

RIO master port from which to release the mailbox resource

*mbox*

Mailbox number to release

## Description

Releases ownership of an inbound mailbox resource. Returns 0 if the request has been satisfied.

# rio\_request\_outb\_mbox

## LINUX

Kernel Hackers ManualSeptember 2014

## Name

`rio_request_outb_mbox` — request outbound mailbox service

## Synopsis

```
int rio_request_outb_mbox (struct rio_mport * mport, void *  
dev_id, int mbox, int entries, void (*moutb) (struct rio_mport  
* mport, void *dev_id, int mbox, int slot));
```

## Arguments

*mport*

RIO master port from which to allocate the mailbox resource

*dev\_id*

Device specific pointer to pass on event

*mbox*

Mailbox number to claim

*entries*

Number of entries in outbound mailbox queue

*moutb*

Callback to execute when outbound message is sent

## Description

Requests ownership of an outbound mailbox resource and binds a callback function to the resource. Returns 0 on success.

## rio\_release\_outb\_mbox

### LINUX

Kernel Hackers ManualSeptember 2014

## Name

rio\_release\_outb\_mbox — release outbound mailbox message service

## Synopsis

```
int rio_release_outb_mbox (struct rio_mport * mport, int
mbox);
```

## Arguments

*mport*

RIO master port from which to release the mailbox resource

*mbox*

Mailbox number to release

## Description

Releases ownership of an inbound mailbox resource. Returns 0 if the request has been satisfied.

# rio\_request\_inb\_dbell

## LINUX

Kernel Hackers ManualSeptember 2014

## Name

`rio_request_inb_dbell` — request inbound doorbell message service

## Synopsis

```
int rio_request_inb_dbell (struct rio_mport * mport, void *
dev_id, ul6 start, ul6 end, void (*dinb) (struct rio_mport *
```



```
mport, void *dev_id, u16 src, u16 dst, u16 info));
```

## Arguments

*mport*

RIO master port from which to allocate the doorbell resource

*dev\_id*

Device specific pointer to pass on event

*start*

Doorbell info range start

*end*

Doorbell info range end

*dinb*

Callback to execute when doorbell is received

## Description

Requests ownership of an inbound doorbell resource and binds a callback function to the resource. Returns 0 if the request has been satisfied.

# rio\_release\_inb\_dbell

**LINUX**

Kernel Hackers ManualSeptember 2014

## Name

rio\_release\_inb\_dbell — release inbound doorbell message service

## Synopsis

```
int rio_release_inb_dbell (struct rio_mport * mport, u16
start, u16 end);
```

## Arguments

*mport*

RIO master port from which to release the doorbell resource

*start*

Doorbell info range start

*end*

Doorbell info range end

## Description

Releases ownership of an inbound doorbell resource and removes callback from the doorbell event list. Returns 0 if the request has been satisfied.

# rio\_request\_outb\_dbell

## LINUX

Kernel Hackers ManualSeptember 2014

## Name

`rio_request_outb_dbell` — request outbound doorbell message range

## Synopsis

```
struct resource * rio_request_outb_dbell (struct rio_dev *  
rdev, u16 start, u16 end);
```

## Arguments

*rdev*

RIO device from which to allocate the doorbell resource

*start*

Doorbell message range start

*end*

Doorbell message range end

## Description

Requests ownership of a doorbell message range. Returns a resource if the request has been satisfied or `NULL` on failure.

# rio\_release\_outb\_dbell

## LINUX

Kernel Hackers ManualSeptember 2014

## Name

`rio_release_outb_dbell` — release outbound doorbell message range

## Synopsis

```
int rio_release_outb_dbell (struct rio_dev * rdev, struct  
resource * res);
```

## Arguments

*rdev*

RIO device from which to release the doorbell resource

*res*

Doorbell resource to be freed

## Description

Releases ownership of a doorbell message range. Returns 0 if the request has been satisfied.

# rio\_request\_inb\_pwrite

## LINUX

Kernel Hackers ManualSeptember 2014

## Name

`rio_request_inb_pwrite` — request inbound port-write message service

## Synopsis

```
int rio_request_inb_pwrite (struct rio_dev * rdev, int  
(*pwcback) (struct rio_dev *rdev, union rio_pw_msg *msg, int
```

```
step));
```

## Arguments

*rdev*

RIO device to which register inbound port-write callback routine

*pwcback*

Callback routine to execute when port-write is received

## Description

Binds a port-write callback function to the RapidIO device. Returns 0 if the request has been satisfied.

# rio\_release\_inb\_pwrite

## LINUX

Kernel Hackers ManualSeptember 2014

## Name

`rio_release_inb_pwrite` — release inbound port-write message service

## Synopsis

```
int rio_release_inb_pwrite (struct rio_dev * rdev);
```

## Arguments

*rdev*

RIO device which registered for inbound port-write callback

## Description

Removes callback from the `rio_dev` structure. Returns 0 if the request has been satisfied.

# rio\_inb\_pwrite\_handler

## LINUX

Kernel Hackers ManualSeptember 2014

## Name

`rio_inb_pwrite_handler` — process inbound port-write message

## Synopsis

```
int rio_inb_pwrite_handler (union rio_pw_msg * pw_msg);
```

## Arguments

*pw\_msg*

pointer to inbound port-write message

## Description

Processes an inbound port-write message. Returns 0 if the request has been satisfied.

## rio\_get\_asm

### LINUX

Kernel Hackers Manual September 2014

## Name

`rio_get_asm` — Begin or continue searching for a RIO device by vid/did/asm\_vid/asm\_did

## Synopsis

```
struct rio_dev * rio_get_asm (u16 vid, u16 did, u16 asm_vid,
u16 asm_did, struct rio_dev * from);
```

## Arguments

*vid*

RIO vid to match or RIO\_ANY\_ID to match all vids

*did*

RIO did to match or RIO\_ANY\_ID to match all dids

*asm\_vid*

RIO asm\_vid to match or RIO\_ANY\_ID to match all asm\_vids

*asm\_did*

RIO asm\_did to match or RIO\_ANY\_ID to match all asm\_dids

*from*

Previous RIO device found in search, or `NULL` for new search

## Description

Iterates through the list of known RIO devices. If a RIO device is found with a matching *vid*, *did*, *asm\_vid*, *asm\_did*, the reference count to the device is incremented and a pointer to its device structure is returned. Otherwise, `NULL` is returned. A new search is initiated by passing `NULL` to the *from* argument. Otherwise, if *from* is not `NULL`, searches continue from next device on the global list. The reference count for *from* is always decremented if it is not `NULL`.

## rio\_get\_device

### LINUX

Kernel Hackers Manual September 2014

### Name

`rio_get_device` — Begin or continue searching for a RIO device by vid/did

### Synopsis

```
struct rio_dev * rio_get_device (u16 vid, u16 did, struct
rio_dev * from);
```

### Arguments

*vid*

RIO vid to match or `RIO_ANY_ID` to match all vids



*did*

RIO did to match or `RIO_ANY_ID` to match all dids

*from*

Previous RIO device found in search, or `NULL` for new search

## Description

Iterates through the list of known RIO devices. If a RIO device is found with a matching *vid* and *did*, the reference count to the device is incremented and a pointer to its device structure is returned. Otherwise, `NULL` is returned. A new search is initiated by passing `NULL` to the *from* argument. Otherwise, if *from* is not `NULL`, searches continue from next device on the global list. The reference count for *from* is always decremented if it is not `NULL`.



# Chapter 4. Internals

This chapter contains the autogenerated documentation of the RapidIO subsystem.

## 4.1. Structures

### struct rio\_switch

**LINUX**

Kernel Hackers ManualSeptember 2014

#### Name

struct rio\_switch — RIO switch info

#### Synopsis

```
struct rio_switch {
    struct list_head node;
    u16 switchid;
    u8 * route_table;
    u32 port_ok;
    int (* add_entry) (struct rio_mport *mport, u16 destid, u8 hopcount,u16
    int (* get_entry) (struct rio_mport *mport, u16 destid, u8 hopcount,u16
    int (* clr_table) (struct rio_mport *mport, u16 destid, u8 hopcount,u16
    int (* set_domain) (struct rio_mport *mport, u16 destid, u8 hopcount,u8
    int (* get_domain) (struct rio_mport *mport, u16 destid, u8 hopcount,u8
    int (* em_init) (struct rio_dev *dev);
    int (* em_handle) (struct rio_dev *dev, u8 swport);
    int (* sw_sysfs) (struct rio_dev *dev, int create);
    struct rio_dev * nextdev[0];
};
```

## Members

node

Node in global list of switches

switchid

Switch ID that is unique across a network

route\_table

Copy of switch routing table

port\_ok

Status of each port (one bit per port) - OK=1 or UNINIT=0

add\_entry

Callback for switch-specific route add function

get\_entry

Callback for switch-specific route get function

clr\_table

Callback for switch-specific clear route table function

set\_domain

Callback for switch-specific domain setting function

get\_domain

Callback for switch-specific domain get function

em\_init

Callback for switch-specific error management init function

em\_handle

Callback for switch-specific error management handler function

sw\_sysfs

Callback that initializes switch-specific sysfs attributes

nextdev[0]

Array of per-port pointers to the next attached device

# struct rio\_dev

## LINUX

Kernel Hackers Manual September 2014

## Name

struct rio\_dev — RIO device info

## Synopsis

```
struct rio_dev {
    struct list_head global_list;
    struct list_head net_list;
    struct rio_net * net;
    u16 did;
    u16 vid;
    u32 device_rev;
    u16 asm_did;
    u16 asm_vid;
    u16 asm_rev;
    u16 efptr;
    u32 pef;
    u32 swpinfo;
    u32 src_ops;
    u32 dst_ops;
    u32 comp_tag;
    u32 phys_efptr;
    u32 em_efptr;
    u64 dma_mask;
    struct rio_driver * driver;
    struct device dev;
    struct resource riores[RIO_MAX_DEV_RESOURCES];
    int (* pwcback) (struct rio_dev *rdev, union rio_pw_msg *msg, int step);
    u16 destid;
    u8 hopcount;
    struct rio_dev * prev;
    struct rio_switch rswitch[0];
};
```

## Members

global\_list

Node in list of all RIO devices

net\_list

Node in list of RIO devices in a network

net

Network this device is a part of

did

Device ID

vid

Vendor ID

device\_rev

Device revision

asm\_did

Assembly device ID

asm\_vid

Assembly vendor ID

asm\_rev

Assembly revision

efptr

Extended feature pointer

pef

Processing element features

swpinfo

Switch port info

src\_ops

Source operation capabilities

`dst_ops`

Destination operation capabilities

`comp_tag`

RIO component tag

`phys_efptr`

RIO device extended features pointer

`em_efptr`

RIO Error Management features pointer

`dma_mask`

Mask of bits of RIO address this device implements

`driver`

Driver claiming this device

`dev`

Device model device

`riores[RIO_MAX_DEV_RESOURCES]`

RIO resources this device owns

`pwcback`

port-write callback function for this device

`destid`

Network destination ID (or associated `destid` for switch)

`hopcount`

Hopcount to this device

`prev`

Previous RIO device connected to the current one

`rswitch[0]`

struct `rio_switch` (if valid for this device)

# struct rio\_msg

## LINUX

Kernel Hackers ManualSeptember 2014

### Name

struct rio\_msg — RIO message event

### Synopsis

```
struct rio_msg {  
    struct resource * res;  
    void (* mcback) (struct rio_mport * mport, void *dev_id, int mbox, int s  
};
```

### Members

res

Mailbox resource

mcback

Message event callback

# struct rio\_dbell

## LINUX

Kernel Hackers ManualSeptember 2014

### Name

struct rio\_dbell — RIO doorbell event



## Synopsis

```
struct rio_dbell {
    struct list_head node;
    struct resource * res;
    void (* dinb) (struct rio_mport *mport, void *dev_id, u16 src, u16 dst,
    void * dev_id;
};
```

## Members

node

Node in list of doorbell events

res

Doorbell resource

dinb

Doorbell event callback

dev\_id

Device specific pointer to pass on event

## struct rio\_mport

### LINUX

Kernel Hackers ManualSeptember 2014

## Name

struct rio\_mport — RIO master port info

## Synopsis

```
struct rio_mport {
```

```
struct list_head dbells;
struct list_head node;
struct list_head nnode;
struct resource iores;
struct resource riores[RIO_MAX_MPORT_RESOURCES];
struct rio_msg inb_msg[RIO_MAX_MBOX];
struct rio_msg outb_msg[RIO_MAX_MBOX];
int host_deviceid;
struct rio_ops * ops;
unsigned char id;
unsigned char index;
unsigned int sys_size;
enum rio_phy_type phy_type;
u32 phys_efptr;
unsigned char name[40];
void * priv;
};
```

## Members

dbells

List of doorbell events

node

Node in global list of master ports

nnode

Node in network list of master ports

iores

I/O mem resource that this master port interface owns

riores[RIO\_MAX\_MPORT\_RESOURCES]

RIO resources that this master port interfaces owns

inb\_msg[RIO\_MAX\_MBOX]

RIO inbound message event descriptors

outb\_msg[RIO\_MAX\_MBOX]

RIO outbound message event descriptors

host\_deviceid

Host device ID associated with this master port

ops

configuration space functions

id

Port ID, unique among all ports

index

Port index, unique among all port interfaces of the same type

sys\_size

RapidIO common transport system size

phy\_type

RapidIO phy type

phys\_efptr

RIO port extended features pointer

name[40]

Port name string

priv

Master port private data

## struct rio\_net

**LINUX**

Kernel Hackers ManualSeptember 2014

### Name

struct rio\_net — RIO network info

## Synopsis

```
struct rio_net {  
    struct list_head node;  
    struct list_head devices;  
    struct list_head mports;  
    struct rio_mport * hport;  
    unsigned char id;  
};
```

## Members

node

Node in global list of RIO networks

devices

List of devices in this network

mports

List of master ports accessing this network

hport

Default port for accessing this network

id

RIO network ID

## struct rio\_ops

### LINUX

Kernel Hackers Manual September 2014

## Name

struct rio\_ops — Low-level RIO configuration space operations

## Synopsis

```
struct rio_ops {
    int (* lcread) (struct rio_mport *mport, int index, u32 offset, int len,
    int (* lcwrite) (struct rio_mport *mport, int index, u32 offset, int len,
    int (* cread) (struct rio_mport *mport, int index, u16 destid, u8 hopcount,
    int (* cwrite) (struct rio_mport *mport, int index, u16 destid, u8 hopcount,
    int (* dsend) (struct rio_mport *mport, int index, u16 destid, u16 data,
    int (* pwenable) (struct rio_mport *mport, int enable);
    int (* open_outb_mbox) (struct rio_mport *mport, void *dev_id, int mbox,
    void (* close_outb_mbox) (struct rio_mport *mport, int mbox);
    int (* open_inb_mbox) (struct rio_mport *mport, void *dev_id, int mbox,
    void (* close_inb_mbox) (struct rio_mport *mport, int mbox);
    int (* add_outb_message) (struct rio_mport *mport, struct rio_dev *rdev,
    int (* add_inb_buffer) (struct rio_mport *mport, int mbox, void *buf);
    void *(* get_inb_message) (struct rio_mport *mport, int mbox);
};
```

## Members

### lcread

Callback to perform local (master port) read of config space.

### lcwrite

Callback to perform local (master port) write of config space.

### cread

Callback to perform network read of config space.

### cwrite

Callback to perform network write of config space.

### dsend

Callback to send a doorbell message.

### pwenable

Callback to enable/disable port-write message handling.

### open\_outb\_mbox

Callback to initialize outbound mailbox.

`close_outb_mbox`

Callback to shut down outbound mailbox.

`open_inb_mbox`

Callback to initialize inbound mailbox.

`close_inb_mbox`

Callback to shut down inbound mailbox.

`add_outb_message`

Callback to add a message to an outbound mailbox queue.

`add_inb_buffer`

Callback to add a buffer to an inbound mailbox queue.

`get_inb_message`

Callback to get a message from an inbound mailbox queue.

## struct rio\_driver

### LINUX

Kernel Hackers Manual September 2014

### Name

`struct rio_driver` — RIO driver info

### Synopsis

```
struct rio_driver {
    struct list_head node;
    char * name;
    const struct rio_device_id * id_table;
    int (* probe) (struct rio_dev * dev, const struct rio_device_id * id);
    void (* remove) (struct rio_dev * dev);
    int (* suspend) (struct rio_dev * dev, u32 state);
    int (* resume) (struct rio_dev * dev);
}
```

```
int (* enable_wake) (struct rio_dev * dev, u32 state, int enable);  
struct device_driver driver;  
};
```

## Members

node

Node in list of drivers

name

RIO driver name

id\_table

RIO device ids to be associated with this driver

probe

RIO device inserted

remove

RIO device removed

suspend

RIO device suspended

resume

RIO device awakened

enable\_wake

RIO device enable wake event

driver

LDM driver struct

## Description

Provides info on a RIO device driver for insertion/removal and power management purposes.

# struct rio\_device\_id

## LINUX

Kernel Hackers ManualSeptember 2014

### Name

`struct rio_device_id` — RIO device identifier

### Synopsis

```
struct rio_device_id {  
    u16 did;  
    u16 vid;  
    u16 asm_did;  
    u16 asm_vid;  
};
```

### Members

`did`

RIO device ID

`vid`

RIO vendor ID

`asm_did`

RIO assembly device ID

`asm_vid`

RIO assembly vendor ID



## Description

Identifies a RIO device based on both the device/vendor IDs and the assembly device/vendor IDs.

## struct rio\_switch\_ops

### LINUX

Kernel Hackers Manual September 2014

## Name

`struct rio_switch_ops` — Per-switch operations

## Synopsis

```
struct rio_switch_ops {
    u16 vid;
    u16 did;
    int (* init_hook) (struct rio_dev *rdev, int do_enum);
};
```

## Members

`vid`

RIO vendor ID

`did`

RIO device ID

`init_hook`

Callback that performs switch device initialization

## Description

Defines the operations that are necessary to initialize/control a particular RIO switch device.

## 4.2. Enumeration and Discovery

### rio\_get\_device\_id

#### LINUX

Kernel Hackers ManualSeptember 2014

#### Name

`rio_get_device_id` — Get the base/extended device id for a device

#### Synopsis

```
u16 rio_get_device_id (struct rio_mport * port, u16 destid, u8  
hopcount);
```

#### Arguments

*port*

RIO master port

*destid*

Destination ID of device

*hopcount*

Hopcount to device

## Description

Reads the base/extended device id from a device. Returns the 8/16-bit device ID.

# rio\_set\_device\_id

## LINUX

Kernel Hackers ManualSeptember 2014

## Name

`rio_set_device_id` — Set the base/extended device id for a device

## Synopsis

```
void rio_set_device_id (struct rio_mport * port, u16 destid,  
u8 hopcount, u16 did);
```

## Arguments

*port*

RIO master port

*destid*

Destination ID of device

*hopcount*

Hopcount to device

*did*

Device ID value to be written

## Description

Writes the base/extended device id from a device.

# rio\_local\_set\_device\_id

## LINUX

Kernel Hackers ManualSeptember 2014

## Name

`rio_local_set_device_id` — Set the base/extended device id for a port

## Synopsis

```
void rio_local_set_device_id (struct rio_mport * port, u16  
did);
```

## Arguments

*port*

RIO master port

*did*

Device ID value to be written

## Description

Writes the base/extended device id from a device.

# rio\_clear\_locks

## LINUX

Kernel Hackers ManualSeptember 2014

## Name

`rio_clear_locks` — Release all host locks and signal enumeration complete

## Synopsis

```
int rio_clear_locks (struct rio_mport * port);
```

## Arguments

*port*

Master port to issue transaction

## Description

Marks the component tag CSR on each device with the enumeration complete flag. When complete, it then release the host locks on each device. Returns 0 on success or `-EINVAL` on failure.

# rio\_enum\_host

## LINUX

Kernel Hackers Manual September 2014

### Name

`rio_enum_host` — Set host lock and initialize host destination ID

### Synopsis

```
int rio_enum_host (struct rio_mport * port);
```

### Arguments

*port*

Master port to issue transaction

### Description

Sets the local host master port lock and destination ID register with the host device ID value. The host device ID value is provided by the platform. Returns 0 on success or -1 on failure.

# rio\_device\_has\_destid

## LINUX

## Name

`rio_device_has_destid` — Test if a device contains a destination ID register

## Synopsis

```
int rio_device_has_destid (struct rio_mport * port, int
src_ops, int dst_ops);
```

## Arguments

*port*

Master port to issue transaction

*src\_ops*

RIO device source operations

*dst\_ops*

RIO device destination operations

## Description

Checks the provided *src\_ops* and *dst\_ops* for the necessary transaction capabilities that indicate whether or not a device will implement a destination ID register. Returns 1 if true or 0 if false.

## `rio_release_dev`

**LINUX**

## Name

`rio_release_dev` — Frees a RIO device struct

## Synopsis

```
void rio_release_dev (struct device * dev);
```

## Arguments

*dev*

LDM device associated with a RIO device struct

## Description

Gets the RIO device struct associated a RIO device struct. The RIO device struct is freed.

# rio\_is\_switch

## LINUX

## Name

`rio_is_switch` — Tests if a RIO device has switch capabilities



## Synopsis

```
int rio_is_switch (struct rio_dev * rdev);
```

## Arguments

*rdev*

RIO device

## Description

Gets the RIO device Processing Element Features register contents and tests for switch capabilities. Returns 1 if the device is a switch or 0 if it is not a switch. The RIO device struct is freed.

## rio\_switch\_init

### LINUX

Kernel Hackers Manual September 2014

## Name

`rio_switch_init` — Sets switch operations for a particular vendor switch

## Synopsis

```
void rio_switch_init (struct rio_dev * rdev, int do_enum);
```

## Arguments

*rdev*

RIO device

*do\_enum*

Enumeration/Discovery mode flag

## Description

Searches the RIO switch ops table for known switch types. If the vid and did match a switch table entry, then call switch initialization routine to setup switch-specific routines.

# rio\_add\_device

## LINUX

Kernel Hackers ManualSeptember 2014

## Name

`rio_add_device` — Adds a RIO device to the device model

## Synopsis

```
int rio_add_device (struct rio_dev * rdev);
```

## Arguments

*rdev*

RIO device

## Description

Adds the RIO device to the global device list and adds the RIO device to the RIO device list. Creates the generic sysfs nodes for an RIO device.

# rio\_enable\_rx\_tx\_port

## LINUX

Kernel Hackers ManualSeptember 2014

## Name

`rio_enable_rx_tx_port` — enable input receiver and output transmitter of given port

## Synopsis

```
int rio_enable_rx_tx_port (struct rio_mport * port, int local,
u16 destid, u8 hopcount, u8 port_num);
```

## Arguments

*port*

Master port associated with the RIO network

*local*

local=1 select local port otherwise a far device is reached

*destid*

Destination ID of the device to check host bit

*hopcount*

Number of hops to reach the target

*port\_num*

Port (-number on switch) to enable on a far end device

## Description

Returns 0 or 1 from on General Control Command and Status Register (EXT\_PTR+0x3C)

# rio\_setup\_device

## LINUX

Kernel Hackers ManualSeptember 2014

## Name

`rio_setup_device` — Allocates and sets up a RIO device

## Synopsis

```
struct rio_dev * rio_setup_device (struct rio_net * net,  
struct rio_mport * port, u16 destid, u8 hopcount, int  
do_enum);
```

## Arguments

*net*

RIO network

*port*

Master port to send transactions

*destid*

Current destination ID

*hopcount*

Current hopcount

*do\_enum*

Enumeration/Discovery mode flag

## Description

Allocates a RIO device and configures fields based on configuration space contents. If device has a destination ID register, a destination ID is either assigned in enumeration mode or read from configuration space in discovery mode. If the device has switch capabilities, then a switch is allocated and configured appropriately. Returns a pointer to a RIO device on success or NULL on failure.

# rio\_sport\_is\_active

## LINUX

Kernel Hackers ManualSeptember 2014

## Name

`rio_sport_is_active` — Tests if a switch port has an active connection.

## Synopsis

```
int rio_sport_is_active (struct rio_mport * port, u16 destid,
u8 hopcount, int sport);
```

## Arguments

*port*

Master port to send transaction

*destid*

Associated destination ID for switch

*hopcount*

Hopcount to reach switch

*sport*

Switch port number

## Description

Reads the port error status CSR for a particular switch port to determine if the port has an active link. Returns `RIO_PORT_N_ERR_STS_PORT_OK` if the port is active or 0 if it is inactive.

## rio\_lock\_device

### LINUX

Kernel Hackers Manual September 2014

### Name

`rio_lock_device` — Acquires host device lock for specified device

### Synopsis

```
int rio_lock_device (struct rio_mport * port, u16 destid, u8  
hopcount, int wait_ms);
```

## Arguments

*port*

Master port to send transaction

*destid*

Destination ID for device/switch

*hopcount*

Hopcount to reach switch

*wait\_ms*

Max wait time in msec (0 = no timeout)

## Description

Attempts to acquire host device lock for specified device Returns 0 if device lock acquired or EINVAL if timeout expires.

# rio\_unlock\_device

## LINUX

Kernel Hackers ManualSeptember 2014

## Name

`rio_unlock_device` — Releases host device lock for specified device

## Synopsis

```
int rio_unlock_device (struct rio_mport * port, u16 destid, u8  
hopcount);
```

## Arguments

*port*

Master port to send transaction

*destid*

Destination ID for device/switch

*hopcount*

Hopcount to reach switch

## Description

Returns 0 if device lock released or EINVAL if fails.

# rio\_route\_add\_entry

**LINUX**

Kernel Hackers ManualSeptember 2014

## Name

`rio_route_add_entry` — Add a route entry to a switch routing table



## Synopsis

```
int rio_route_add_entry (struct rio_dev * rdev, u16 table, u16
route_destid, u8 route_port, int lock);
```

## Arguments

*rdev*

RIO device

*table*

Routing table ID

*route\_destid*

Destination ID to be routed

*route\_port*

Port number to be routed

*lock*

lock switch device flag

## Description

Calls the switch specific `add_entry` method to add a route entry on a switch. The route table can be specified using the *table* argument if a switch has per port routing tables or the normal use is to specific all tables (or the global table) by passing `RIO_GLOBAL_TABLE` in *table*. Returns 0 on success or `-EINVAL` on failure.

## rio\_route\_get\_entry

**LINUX**

## Name

`rio_route_get_entry` — Read a route entry in a switch routing table

## Synopsis

```
int rio_route_get_entry (struct rio_dev * rdev, u16 table, u16
route_destid, u8 * route_port, int lock);
```

## Arguments

*rdev*

RIO device

*table*

Routing table ID

*route\_destid*

Destination ID to be routed

*route\_port*

Pointer to read port number into

*lock*

lock switch device flag

## Description

Calls the switch specific `get_entry` method to read a route entry in a switch. The route table can be specified using the *table* argument if a switch has per port routing tables or the normal use is to specific all tables (or the global table) by passing `RIO_GLOBAL_TABLE` in *table*. Returns 0 on success or `-EINVAL` on failure.

# rio\_get\_host\_deviceid\_lock

## LINUX

Kernel Hackers ManualSeptember 2014

### Name

`rio_get_host_deviceid_lock` — Reads the Host Device ID Lock CSR on a device

### Synopsis

```
u16 rio_get_host_deviceid_lock (struct rio_mport * port, u8  
hopcount);
```

### Arguments

*port*

Master port to send transaction

*hopcount*

Number of hops to the device

### Description

Used during enumeration to read the Host Device ID Lock CSR on a RIO device. Returns the value of the lock register.

# rio\_enum\_peer

## LINUX

Kernel Hackers ManualSeptember 2014

### Name

`rio_enum_peer` — Recursively enumerate a RIO network through a master port

### Synopsis

```
int rio_enum_peer (struct rio_net * net, struct rio_mport *  
port, u8 hopcount, struct rio_dev * prev, int prev_port);
```

### Arguments

*net*

RIO network being enumerated

*port*

Master port to send transactions

*hopcount*

Number of hops into the network

*prev*

Previous RIO device connected to the enumerated one

*prev\_port*

Port on previous RIO device

## Description

Recursively enumerates a RIO network. Transactions are sent via the master port passed in *port*.

# rio\_enum\_complete

## LINUX

Kernel Hackers ManualSeptember 2014

## Name

`rio_enum_complete` — Tests if enumeration of a network is complete

## Synopsis

```
int rio_enum_complete (struct rio_mport * port);
```

## Arguments

*port*

Master port to send transaction

## Description

Tests the Component Tag CSR for non-zero value (enumeration complete flag). Return 1 if enumeration is complete or 0 if enumeration is incomplete.

# rio\_disc\_peer

## LINUX

Kernel Hackers ManualSeptember 2014

### Name

`rio_disc_peer` — Recursively discovers a RIO network through a master port

### Synopsis

```
int rio_disc_peer (struct rio_net * net, struct rio_mport *  
port, u16 destid, u8 hopcount, struct rio_dev * prev, int  
prev_port);
```

### Arguments

*net*

RIO network being discovered

*port*

Master port to send transactions

*destid*

Current destination ID in network

*hopcount*

Number of hops into the network

*prev*

previous `rio_dev`

*prev\_port*

previous port number

## Description

Recursively discovers a RIO network. Transactions are sent via the master port passed in *port*.

# rio\_mport\_is\_active

## LINUX

Kernel Hackers ManualSeptember 2014

## Name

`rio_mport_is_active` — Tests if master port link is active

## Synopsis

```
int rio_mport_is_active (struct rio_mport * port);
```

## Arguments

*port*

Master port to test

## Description

Reads the port error status CSR for the master port to determine if the port has an active link. Returns `RIO_PORT_N_ERR_STS_PORT_OK` if the master port is active or 0 if it is inactive.

# rio\_alloc\_net

## LINUX

Kernel Hackers ManualSeptember 2014

### Name

`rio_alloc_net` — Allocate and configure a new RIO network

### Synopsis

```
struct rio_net * rio_alloc_net (struct rio_mport * port);
```

### Arguments

*port*

Master port associated with the RIO network

### Description

Allocates a RIO network structure, initializes per-network list heads, and adds the associated master port to the network list of associated master ports. Returns a RIO network pointer on success or `NULL` on failure.

# rio\_update\_route\_tables

## LINUX



## Name

`rio_update_route_tables` — Updates route tables in switches

## Synopsis

```
void rio_update_route_tables (struct rio_mport * port);
```

## Arguments

*port*

Master port associated with the RIO network

## Description

For each enumerated device, ensure that each switch in a system has correct routing entries. Add routes for devices that where unknown during the first enumeration pass through the switch.

## rio\_init\_em

### LINUX

## Name

`rio_init_em` — Initializes RIO Error Management (for switches)

## Synopsis

```
void rio_init_em (struct rio_dev * rdev);
```

## Arguments

*rdev*

RIO device

## Description

For each enumerated switch, call device-specific error management initialization routine (if supplied by the switch driver).

## rio\_pw\_enable

### LINUX

Kernel Hackers ManualSeptember 2014

## Name

`rio_pw_enable` — Enables/disables port-write handling by a master port

## Synopsis

```
void rio_pw_enable (struct rio_mport * port, int enable);
```

## Arguments

*port*

Master port associated with port-write handling

*enable*

1=enable, 0=disable

## rio\_enum\_mport

### LINUX

Kernel Hackers Manual September 2014

### Name

`rio_enum_mport` — Start enumeration through a master port

### Synopsis

```
int rio_enum_mport (struct rio_mport * mport);
```

## Arguments

*mport*

Master port to send transactions

## Description

Starts the enumeration process. If somebody has enumerated our master port device, then give up. If not and we have an active link, then start recursive peer enumeration. Returns 0 if enumeration succeeds or `-EBUSY` if enumeration fails.

## rio\_build\_route\_tables

**LINUX**

Kernel Hackers ManualSeptember 2014

### Name

`rio_build_route_tables` — Generate route tables from switch route entries

### Synopsis

```
void rio_build_route_tables ( void );
```

### Arguments

*void*

no arguments

### Description

For each switch device, generate a route table by copying existing route entries from the switch.

## rio\_enum\_timeout

**LINUX**

## Name

`rio_enum_timeout` — Signal that enumeration timed out

## Synopsis

```
void rio_enum_timeout (unsigned long data);
```

## Arguments

*data*

Address of timeout flag.

## Description

When the enumeration complete timer expires, set a flag that signals to the discovery process that enumeration did not complete in a sane amount of time.

# rio\_disc\_mport

## LINUX

## Name

`rio_disc_mport` — Start discovery through a master port

## Synopsis

```
int rio_disc_mport (struct rio_mport * mport);
```

## Arguments

*mport*

Master port to send transactions

## Description

Starts the discovery process. If we have an active link, then wait for the signal that enumeration is complete. When enumeration completion is signaled, start recursive peer discovery. Returns 0 if discovery succeeds or `-EBUSY` on failure.

## 4.3. Driver functionality

### rio\_setup\_inb\_dbell

#### LINUX

Kernel Hackers Manual September 2014

#### Name

`rio_setup_inb_dbell` — bind inbound doorbell callback

## Synopsis

```
int rio_setup_inb_dbell (struct rio_mport * mport, void *
dev_id, struct resource * res, void (*dinb) (struct rio_mport
* mport, void *dev_id, u16 src, u16 dst, u16 info));
```

## Arguments

*mport*

RIO master port to bind the doorbell callback

*dev\_id*

Device specific pointer to pass on event

*res*

Doorbell message resource

*dinb*

Callback to execute when doorbell is received

## Description

Adds a doorbell resource/callback pair into a port's doorbell event list. Returns 0 if the request has been satisfied.

## rio\_mport\_get\_physefb

**LINUX**

## Name

`rio_mport_get_physefb` — Helper function that returns register offset for Physical Layer Extended Features Block.

## Synopsis

```
u32 rio_mport_get_physefb (struct rio_mport * port, int local,  
u16 destid, u8 hopcount);
```

## Arguments

*port*

Master port to issue transaction

*local*

Indicate a local master port or remote device access

*destid*

Destination ID of the device

*hopcount*

Number of switch hops to the device

## `rio_get_comptag`

**LINUX**



## Name

`rio_get_comptag` — Begin or continue searching for a RIO device by component tag

## Synopsis

```
struct rio_dev * rio_get_comptag (u32 comp_tag, struct rio_dev  
* from);
```

## Arguments

*comp\_tag*

RIO component tag to match

*from*

Previous RIO device found in search, or `NULL` for new search

## Description

Iterates through the list of known RIO devices. If a RIO device is found with a matching *comp\_tag*, a pointer to its device structure is returned. Otherwise, `NULL` is returned. A new search is initiated by passing `NULL` to the *from* argument. Otherwise, if *from* is not `NULL`, searches continue from next device on the global list.

## `rio_set_port_lockout`

**LINUX**

## Name

`rio_set_port_lockout` — Sets/clears LOCKOUT bit (RIO EM 1.3) for a switch port.

## Synopsis

```
int rio_set_port_lockout (struct rio_dev * rdev, u32 pnum, int lock);
```

## Arguments

*rdev*

Pointer to RIO device control structure

*pnum*

Switch port number to set LOCKOUT bit

*lock*

Operation : set (=1) or clear (=0)

# rio\_chk\_dev\_route

## LINUX

## Name

`rio_chk_dev_route` — Validate route to the specified device.

## Synopsis

```
int rio_chk_dev_route (struct rio_dev * rdev, struct rio_dev
** nrdev, int * npnum);
```

## Arguments

*rdev*

RIO device failed to respond

*nrdev*

Last active device on the route to rdev

*npnum*

nrdev's port number on the route to rdev

## Description

Follows a route to the specified RIO device to determine the last available device (and corresponding RIO port) on the route.

# rio\_mport\_chk\_dev\_access

## LINUX

Kernel Hackers ManualSeptember 2014

## Name

`rio_mport_chk_dev_access` — Validate access to the specified device.

## Synopsis

```
int rio_mport_chk_dev_access (struct rio_mport * mport, u16  
destid, u8 hopcount);
```

## Arguments

*mport*

Master port to send transactions

*destid*

Device destination ID in network

*hopcount*

Number of hops into the network

## rio\_chk\_dev\_access

### LINUX

Kernel Hackers ManualSeptember 2014

## Name

`rio_chk_dev_access` — Validate access to the specified device.

## Synopsis

```
int rio_chk_dev_access (struct rio_dev * rdev);
```

## Arguments

*rdev*

Pointer to RIO device control structure

# rio\_get\_input\_status

## LINUX

Kernel Hackers Manual September 2014

## Name

`rio_get_input_status` — Sends a Link-Request/Input-Status control symbol and returns link-response (if requested).

## Synopsis

```
int rio_get_input_status (struct rio_dev * rdev, int pnum, u32
* lnkresp);
```

## Arguments

*rdev*

RIO devive to issue Input-status command

*pnum*

Device port number to issue the command

*lnkresp*

Response from a link partner

# rio\_clr\_err\_stopped

## LINUX

Kernel Hackers ManualSeptember 2014

### Name

`rio_clr_err_stopped` — Clears port Error-stopped states.

### Synopsis

```
int rio_clr_err_stopped (struct rio_dev * rdev, u32 pnum, u32
err_status);
```

### Arguments

*rdev*

Pointer to RIO device control structure

*pnum*

Switch port number to clear errors

*err\_status*

port error status (if 0 reads register from device)

# rio\_mport\_get\_efb

## LINUX

## Name

`rio_mport_get_efb` — get pointer to next extended features block

## Synopsis

```
u32 rio_mport_get_efb (struct rio_mport * port, int local, u16  
destid, u8 hopcount, u32 from);
```

## Arguments

*port*

Master port to issue transaction

*local*

Indicate a local master port or remote device access

*destid*

Destination ID of the device

*hopcount*

Number of switch hops to the device

*from*

Offset of current Extended Feature block header (if 0 starts from  
ExtFeaturePtr)

## `rio_mport_get_feature`

**LINUX**

## Name

`rio_mport_get_feature` — query for devices' extended features

## Synopsis

```
u32 rio_mport_get_feature (struct rio_mport * port, int local,  
u16 destid, u8 hopcount, int ftr);
```

## Arguments

*port*

Master port to issue transaction

*local*

Indicate a local master port or remote device access

*destid*

Destination ID of the device

*hopcount*

Number of switch hops to the device

*ftr*

Extended feature code

## Description

Tell if a device supports a given RapidIO capability. Returns the offset of the requested extended feature block within the device's RIO configuration space or 0 in case the device does not support it. Possible values for *ftr*:

`RIO_EFB_PAR_EP_ID` LP/LVDS EP Devices

`RIO_EFB_PAR_EP_REC_ID` LP/LVDS EP Recovery Devices



RIO\_EFB\_PAR\_EP\_FREE\_ID LP/LVDS EP Free Devices

RIO\_EFB\_SER\_EP\_ID LP/Serial EP Devices

RIO\_EFB\_SER\_EP\_REC\_ID LP/Serial EP Recovery Devices

RIO\_EFB\_SER\_EP\_FREE\_ID LP/Serial EP Free Devices

## rio\_std\_route\_add\_entry

### LINUX

Kernel Hackers ManualSeptember 2014

### Name

`rio_std_route_add_entry` — Add switch route table entry using standard registers defined in RIO specification rev.1.3

### Synopsis

```
int rio_std_route_add_entry (struct rio_mport * mport, u16
destid, u8 hopcount, u16 table, u16 route_destid, u8
route_port);
```

### Arguments

*mport*

Master port to issue transaction

*destid*

Destination ID of the device

*hopcount*

Number of switch hops to the device

*table*

routing table ID (global or port-specific)

*route\_destid*

destID entry in the RT

*route\_port*

destination port for specified destID

## rio\_std\_route\_get\_entry

### LINUX

Kernel Hackers Manual September 2014

### Name

`rio_std_route_get_entry` — Read switch route table entry (port number) associated with specified destID using standard registers defined in RIO specification rev.1.3

### Synopsis

```
int rio_std_route_get_entry (struct rio_mport * mport, u16
destid, u8 hopcount, u16 table, u16 route_destid, u8 *
route_port);
```

### Arguments

*mport*

Master port to issue transaction

*destid*

Destination ID of the device

*hopcount*

Number of switch hops to the device

*table*

routing table ID (global or port-specific)

*route\_destid*

destID entry in the RT

*route\_port*

returned destination port for specified destID

## rio\_std\_route\_clr\_table

### LINUX

Kernel Hackers Manual September 2014

### Name

`rio_std_route_clr_table` — Clear swotch route table using standard registers defined in RIO specification rev.1.3.

### Synopsis

```
int rio_std_route_clr_table (struct rio_mport * mport, u16
destid, u8 hopcount, u16 table);
```

## Arguments

*mport*

Master port to issue transaction

*destid*

Destination ID of the device

*hopcount*

Number of switch hops to the device

*table*

routing table ID (global or port-specific)

## RIO\_LOP\_READ

### LINUX

Kernel Hackers ManualSeptember 2014

### Name

RIO\_LOP\_READ — Generate rio\_local\_read\_config\_\* functions

### Synopsis

```
RIO_LOP_READ ( size, type, len );
```

### Arguments

*size*

Size of configuration space read (8, 16, 32 bits)

*type*

C type of value argument

*len*

Length of configuration space read (1, 2, 4 bytes)

## Description

Generates `rio_local_read_config_*` functions used to access configuration space registers on the local device.

# RIO\_LOP\_WRITE

## LINUX

Kernel Hackers Manual September 2014

## Name

`RIO_LOP_WRITE` — Generate `rio_local_write_config_*` functions

## Synopsis

```
RIO_LOP_WRITE ( size, type, len );
```

## Arguments

*size*

Size of configuration space write (8, 16, 32 bits)

*type*

C type of value argument

*len*

Length of configuration space write (1, 2, 4 bytes)

## Description

Generates `rio_local_write_config_*` functions used to access configuration space registers on the local device.

# RIO\_OP\_READ

## LINUX

Kernel Hackers ManualSeptember 2014

## Name

RIO\_OP\_READ — Generate `rio_mport_read_config_*` functions

## Synopsis

```
RIO_OP_READ ( size, type, len );
```

## Arguments

*size*

Size of configuration space read (8, 16, 32 bits)

*type*

C type of value argument

*len*

Length of configuration space read (1, 2, 4 bytes)

## Description

Generates `rio_mport_read_config_*` functions used to access configuration space registers on the local device.

# RIO\_OP\_WRITE

## LINUX

Kernel Hackers Manual September 2014

## Name

`RIO_OP_WRITE` — Generate `rio_mport_write_config_*` functions

## Synopsis

```
RIO_OP_WRITE ( size, type, len );
```

## Arguments

*size*

Size of configuration space write (8, 16, 32 bits)

*type*

C type of value argument

*len*

Length of configuration space write (1, 2, 4 bytes)

## Description

Generates `rio_mport_write_config_*` functions used to access configuration space registers on the local device.

## 4.4. Device model support

### rio\_match\_device

#### LINUX

Kernel Hackers Manual September 2014

#### Name

`rio_match_device` — Tell if a RIO device has a matching RIO device id structure

#### Synopsis

```
const struct rio_device_id * rio_match_device (const struct
rio_device_id * id, const struct rio_dev * rdev);
```

#### Arguments

*id*

the RIO device id structure to match against

*rdev*

the RIO device structure to match against



## Description

Used from driver probe and bus matching to check whether a RIO device matches a device id structure provided by a RIO driver. Returns the matching struct `rio_device_id` or `NULL` if there is no match.

# rio\_device\_probe

## LINUX

Kernel Hackers ManualSeptember 2014

## Name

`rio_device_probe` — Tell if a RIO device structure has a matching RIO device id structure

## Synopsis

```
int rio_device_probe (struct device * dev);
```

## Arguments

*dev*

the RIO device structure to match against

## Description

return 0 and set `rio_dev->driver` when drv claims `rio_dev`, else error

# rio\_device\_remove

## LINUX

Kernel Hackers ManualSeptember 2014

### Name

`rio_device_remove` — Remove a RIO device from the system

### Synopsis

```
int rio_device_remove (struct device * dev);
```

### Arguments

*dev*

the RIO device structure to match against

### Description

Remove a RIO device from the system. If it has an associated driver, then run the `driver_remove` method. Then update the reference count.

# rio\_match\_bus

## LINUX

## Name

`rio_match_bus` — Tell if a RIO device structure has a matching RIO driver device id structure

## Synopsis

```
int rio_match_bus (struct device * dev, struct device_driver *  
drv);
```

## Arguments

*dev*

the standard device structure to match against

*drv*

the standard driver structure containing the ids to match against

## Description

Used by a driver to check whether a RIO device present in the system is in its list of supported devices. Returns 1 if there is a matching struct `rio_device_id` or 0 if there is no match.

## `rio_bus_init`

**LINUX**

## Name

`rio_bus_init` — Register the RapidIO bus with the device model

## Synopsis

```
int rio_bus_init ( void );
```

## Arguments

*void*

no arguments

## Description

Registers the RIO bus device and RIO bus type with the Linux device model.

## 4.5. Sysfs support

### `rio_create_sysfs_dev_files`

#### **LINUX**

## Name

`rio_create_sysfs_dev_files` — create RIO specific sysfs files

## Synopsis

```
int rio_create_sysfs_dev_files (struct rio_dev * rdev);
```

## Arguments

*rdev*

device whose entries should be created

## Description

Create files when *rdev* is added to sysfs.

# rio\_remove\_sysfs\_dev\_files

## LINUX

Kernel Hackers ManualSeptember 2014

## Name

`rio_remove_sysfs_dev_files` — cleanup RIO specific sysfs files

## Synopsis

```
void rio_remove_sysfs_dev_files (struct rio_dev * rdev);
```

## Arguments

*rdev*

device whose entries we should free

## Description

Cleanup when *rdev* is removed from sysfs.

## 4.6. PPC32 support

### fsl\_rio\_doorbell\_send

#### LINUX

Kernel Hackers ManualSeptember 2014

## Name

`fsl_rio_doorbell_send` — Send a MPC85xx doorbell message

## Synopsis

```
int fsl_rio_doorbell_send (struct rio_mport * mport, int
index, u16 destid, u16 data);
```

## Arguments

*mport*

RapidIO master port info

*index*

ID of RapidIO interface

*destid*

Destination ID of target device

*data*

16-bit info field of RapidIO doorbell message

## Description

Sends a MPC85xx doorbell message. Returns 0 on success or `-EINVAL` on failure.

# fsl\_local\_config\_read

## LINUX

Kernel Hackers ManualSeptember 2014

## Name

`fsl_local_config_read` — Generate a MPC85xx local config space read

## Synopsis

```
int fsl_local_config_read (struct rio_mport * mport, int
index, u32 offset, int len, u32 * data);
```

## Arguments

*mport*

RapidIO master port info

*index*

ID of RapdiIO interface

*offset*

Offset into configuration space

*len*

Length (in bytes) of the maintenance transaction

*data*

Value to be read into

## Description

Generates a MPC85xx local configuration space read. Returns 0 on success or `-EINVAL` on failure.

# fsl\_local\_config\_write

## LINUX

Kernel Hackers ManualSeptember 2014

## Name

`fsl_local_config_write` — Generate a MPC85xx local config space write

## Synopsis

```
int fsl_local_config_write (struct rio_mport * mport, int
index, u32 offset, int len, u32 data);
```



## Arguments

*mport*

RapidIO master port info

*index*

ID of RapidIO interface

*offset*

Offset into configuration space

*len*

Length (in bytes) of the maintenance transaction

*data*

Value to be written

## Description

Generates a MPC85xx local configuration space write. Returns 0 on success or `-EINVAL` on failure.

# fsl\_rio\_config\_read

## LINUX

Kernel Hackers Manual September 2014

## Name

`fsl_rio_config_read` — Generate a MPC85xx read maintenance transaction

## Synopsis

```
int fsl_rio_config_read (struct rio_mport * mport, int index,  
u16 destid, u8 hopcount, u32 offset, int len, u32 * val);
```

## Arguments

*mport*

RapidIO master port info

*index*

ID of RapidIO interface

*destid*

Destination ID of transaction

*hopcount*

Number of hops to target device

*offset*

Offset into configuration space

*len*

Length (in bytes) of the maintenance transaction

*val*

Location to be read into

## Description

Generates a MPC85xx read maintenance transaction. Returns 0 on success or `-EINVAL` on failure.

# fsl\_rio\_config\_write

## LINUX

Kernel Hackers Manual September 2014

### Name

`fsl_rio_config_write` — Generate a MPC85xx write maintenance transaction

### Synopsis

```
int fsl_rio_config_write (struct rio_mport * mport, int index,  
u16 destid, u8 hopcount, u32 offset, int len, u32 val);
```

### Arguments

*mport*

RapidIO master port info

*index*

ID of RapidIO interface

*destid*

Destination ID of transaction

*hopcount*

Number of hops to target device

*offset*

Offset into configuration space

*len*

Length (in bytes) of the maintenance transaction

*val*

Value to be written

## Description

Generates an MPC85xx write maintenance transaction. Returns 0 on success or `-EINVAL` on failure.

# fsl\_add\_outb\_message

## LINUX

Kernel Hackers Manual September 2014

## Name

`fsl_add_outb_message` — Add message to the MPC85xx outbound message queue

## Synopsis

```
int fsl_add_outb_message (struct rio_mport * mport, struct
rio_dev * rdev, int mbox, void * buffer, size_t len);
```

## Arguments

*mport*

Master port with outbound message queue

*rdev*

Target of outbound message

*mbox*

Outbound mailbox

*buffer*

Message to add to outbound queue

*len*

Length of message

## Description

Adds the *buffer* message to the MPC85xx outbound message queue. Returns 0 on success or `-EINVAL` on failure.

# fsl\_rio\_tx\_handler

## LINUX

Kernel Hackers ManualSeptember 2014

## Name

`fsl_rio_tx_handler` — MPC85xx outbound message interrupt handler

## Synopsis

```
irqreturn_t fsl_rio_tx_handler (int irq, void * dev_instance);
```

## Arguments

*irq*

Linux interrupt number

*dev\_instance*

Pointer to interrupt-specific data

## Description

Handles outbound message interrupts. Executes a register outbound mailbox event handler and acks the interrupt occurrence.

# fsl\_open\_outb\_mbox

## LINUX

Kernel Hackers ManualSeptember 2014

## Name

`fsl_open_outb_mbox` — Initialize MPC85xx outbound mailbox

## Synopsis

```
int fsl_open_outb_mbox (struct rio_mport * mport, void *  
dev_id, int mbox, int entries);
```

## Arguments

*mport*

Master port implementing the outbound message unit

*dev\_id*

Device specific pointer to pass on event

*mbox*

Mailbox to open

*entries*

Number of entries in the outbound mailbox ring

## Description

Initializes buffer ring, request the outbound message interrupt, and enables the outbound message unit. Returns 0 on success and `-EINVAL` or `-ENOMEM` on failure.

# fsl\_close\_outb\_mbox

## LINUX

Kernel Hackers ManualSeptember 2014

## Name

`fsl_close_outb_mbox` — Shut down MPC85xx outbound mailbox

## Synopsis

```
void fsl_close_outb_mbox (struct rio_mport * mport, int mbox);
```

## Arguments

*mport*

Master port implementing the outbound message unit

*mbox*

Mailbox to close

## Description

Disables the outbound message unit, free all buffers, and frees the outbound message interrupt.

# fsl\_rio\_rx\_handler

## LINUX

Kernel Hackers ManualSeptember 2014

## Name

`fsl_rio_rx_handler` — MPC85xx inbound message interrupt handler

## Synopsis

```
irqreturn_t fsl_rio_rx_handler (int irq, void * dev_instance);
```

## Arguments

*irq*

Linux interrupt number

*dev\_instance*

Pointer to interrupt-specific data

## Description

Handles inbound message interrupts. Executes a registered inbound mailbox event handler and acks the interrupt occurrence.



# fsl\_open\_inb\_mbox

## LINUX

Kernel Hackers Manual September 2014

### Name

`fsl_open_inb_mbox` — Initialize MPC85xx inbound mailbox

### Synopsis

```
int fsl_open_inb_mbox (struct rio_mport * mport, void *  
dev_id, int mbox, int entries);
```

### Arguments

*mport*

Master port implementing the inbound message unit

*dev\_id*

Device specific pointer to pass on event

*mbox*

Mailbox to open

*entries*

Number of entries in the inbound mailbox ring

### Description

Initializes buffer ring, request the inbound message interrupt, and enables the inbound message unit. Returns 0 on success and `-EINVAL` or `-ENOMEM` on failure.

# fsl\_close\_inb\_mbox

## LINUX

Kernel Hackers ManualSeptember 2014

### Name

`fsl_close_inb_mbox` — Shut down MPC85xx inbound mailbox

### Synopsis

```
void fsl_close_inb_mbox (struct rio_mport * mport, int mbox);
```

### Arguments

*mport*

Master port implementing the inbound message unit

*mbox*

Mailbox to close

### Description

Disables the inbound message unit, free all buffers, and frees the inbound message interrupt.

# fsl\_add\_inb\_buffer

## LINUX

## Name

`fsl_add_inb_buffer` — Add buffer to the MPC85xx inbound message queue

## Synopsis

```
int fsl_add_inb_buffer (struct rio_mport * mport, int mbox,  
void * buf);
```

## Arguments

*mport*

Master port implementing the inbound message unit

*mbox*

Inbound mailbox number

*buf*

Buffer to add to inbound queue

## Description

Adds the *buf* buffer to the MPC85xx inbound message queue. Returns 0 on success or `-EINVAL` on failure.

## `fsl_get_inb_message`

**LINUX**

## Name

`fsl_get_inb_message` — Fetch inbound message from the MPC85xx message unit

## Synopsis

```
void * fsl_get_inb_message (struct rio_mport * mport, int mbox);
```

## Arguments

*mport*

Master port implementing the inbound message unit

*mbox*

Inbound mailbox number

## Description

Gets the next available inbound message from the inbound message queue. A pointer to the message is returned on success or NULL on failure.

## `fsl_rio_dbell_handler`

**LINUX**

## Name

`fsl_rio_dbell_handler` — MPC85xx doorbell interrupt handler

## Synopsis

```
irqreturn_t fsl_rio_dbell_handler (int irq, void *  
dev_instance);
```

## Arguments

*irq*

Linux interrupt number

*dev\_instance*

Pointer to interrupt-specific data

## Description

Handles doorbell interrupts. Parses a list of registered doorbell event handlers and executes a matching event handler.

## `fsl_rio_doorbell_init`

**LINUX**

## Name

`fsl_rio_doorbell_init` — MPC85xx doorbell interface init

## Synopsis

```
int fsl_rio_doorbell_init (struct rio_mport * mport);
```

## Arguments

*mport*

Master port implementing the inbound doorbell unit

## Description

Initializes doorbell unit hardware and inbound DMA buffer ring. Called from `fsl_rio_setup`. Returns 0 on success or `-ENOMEM` on failure.

# fsl\_rio\_port\_write\_handler

## LINUX

## Name

`fsl_rio_port_write_handler` — MPC85xx port write interrupt handler

## Synopsis

```
irqreturn_t fsl_rio_port_write_handler (int irq, void *  
dev_instance);
```

## Arguments

*irq*

Linux interrupt number

*dev\_instance*

Pointer to interrupt-specific data

## Description

Handles port write interrupts. Parses a list of registered port write event handlers and executes a matching event handler.

## fsl\_rio\_pw\_enable

### LINUX

Kernel Hackers Manual September 2014

## Name

`fsl_rio_pw_enable` — enable/disable port-write interface init

## Synopsis

```
int fsl_rio_pw_enable (struct rio_mport * mport, int enable);
```

## Arguments

*mport*

Master port implementing the port write unit

*enable*

1=enable; 0=disable port-write message handling

## fsl\_rio\_port\_write\_init

### LINUX

Kernel Hackers ManualSeptember 2014

## Name

`fsl_rio_port_write_init` — MPC85xx port write interface init

## Synopsis

```
int fsl_rio_port_write_init (struct rio_mport * mport);
```

## Arguments

*mport*

Master port implementing the port write unit



## Description

Initializes port write unit hardware and DMA buffer ring. Called from `fsl_rio_setup`. Returns 0 on success or `-ENOMEM` on failure.

## fsl\_rio\_setup

### LINUX

Kernel Hackers Manual September 2014

## Name

`fsl_rio_setup` — Setup Freescale PowerPC RapidIO interface

## Synopsis

```
int fsl_rio_setup (struct platform_device * dev);
```

## Arguments

*dev*

platform\_device pointer

## Description

Initializes MPC85xx RapidIO hardware interface, configures master port with system-specific info, and registers the master port with the RapidIO subsystem.



# Chapter 5. Credits

The following people have contributed to the RapidIO subsystem directly or indirectly:

1. Matt Porter<mporter@kernel.crashing.org>
2. Randy Vinson<rvinson@mvista.com>
3. Dan Malek<dan@embeddedalley.com>

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