

# 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.

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# Chapter 2. Known Bugs and Limitations

## Bugs

None. ;)

## Limitations

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

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# 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.

## Functions

## 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

|               |                                       |
|---------------|---------------------------------------|
| <i>port</i>   | Master port                           |
| <i>offset</i> | Offset into local configuration space |
| <i>data</i>   | Pointer to read data into             |

## Description

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

## 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

|               |                                       |
|---------------|---------------------------------------|
| <i>port</i>   | Master port                           |
| <i>offset</i> | Offset into local configuration space |
| <i>data</i>   | Data to be written                    |

## Description

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



## 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

|               |                                       |
|---------------|---------------------------------------|
| <i>port</i>   | Master port                           |
| <i>offset</i> | Offset into local configuration space |
| <i>data</i>   | Pointer to read data into             |

## Description

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

## 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

|               |                                       |
|---------------|---------------------------------------|
| <i>port</i>   | Master port                           |
| <i>offset</i> | Offset into local configuration space |
| <i>data</i>   | Data to be written                    |

## Description

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

## 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

|               |                                       |
|---------------|---------------------------------------|
| <i>port</i>   | Master port                           |
| <i>offset</i> | Offset into local configuration space |
| <i>data</i>   | Pointer to read data into             |

## Description

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

## 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

|               |                                       |
|---------------|---------------------------------------|
| <i>port</i>   | Master port                           |
| <i>offset</i> | Offset into local configuration space |
| <i>data</i>   | Data to be written                    |

## Description

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

## 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

|               |  |
|---------------|--|
| <i>rdev</i>   | RIO device                             |
| <i>offset</i> | Offset into device configuration space |
| <i>data</i>   | Pointer to read data into              |

## Description

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

## 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.

## 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

|               |  |
|---------------|--|
| <i>rdev</i>   | RIO device                             |
| <i>offset</i> | Offset into device configuration space |
| <i>data</i>   | Pointer to read data into              |

## Description

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

## 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

|               |  |
|---------------|--|
| <i>rdev</i>   | RIO device                             |
| <i>offset</i> | Offset into device configuration space |
| <i>data</i>   | Data to be written                     |

## Description

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



## 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

|               |  |
|---------------|--|
| <i>rdev</i>   | RIO device                             |
| <i>offset</i> | Offset into device configuration space |
| <i>data</i>   | Pointer to read data into              |

## Description

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

## 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.

## 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.

## 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.

## 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.

## 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`.

## 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.

## 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.



## 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.

## 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.

## 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.

## 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.

## 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.

## 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.

## 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.

## 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`.



## Name

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

## Synopsis

```
ul64 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.

## 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.

## 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.

## 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.

## 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

|                |   |
|----------------|---|
| <i>mport</i>   | RIO master port from which to allocate the mailbox resource |
| <i>dev_id</i>  | Device specific pointer to pass on event                    |
| <i>mbox</i>    | Mailbox number to claim                                     |
| <i>entries</i> | Number of entries in outbound mailbox queue                 |
| <i>moutb</i>   | 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.

## 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.

## Name

`rio_request_inb_dbell` — request inbound doorbell message service

## Synopsis

```
int rio_request_inb_dbell (struct rio_mport * mport, void * dev_id, u16
start, u16 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.

## 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.



## 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.

## 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.

## 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.

## 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.

## Name

`rio_map_inb_region` — - Map inbound memory region.

## Synopsis

```
int rio_map_inb_region (struct rio_mport * mport, dma_addr_t local, u64
rbase, u32 size, u32 rflags);
```

## Arguments

|               |  |
|---------------|--|
| <i>mport</i>  | Master port.                                   |
| <i>local</i>  | physical address of memory region to be mapped |
| <i>rbase</i>  | RIO base address assigned to this window       |
| <i>size</i>   | Size of the memory region                      |
| <i>rflags</i> | Flags for mapping.                             |

## Return

0 -- Success.

This function will create the mapping from RIO space to local memory.

## Name

`rio_unmap_inb_region` — - Unmap the inbound memory region

## Synopsis

```
void rio_unmap_inb_region (struct rio_mport * mport, dma_addr_t lstart);
```

## Arguments

*mport*     Master port

*lstart*    physical address of memory region to be unmapped

## 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

|                 |  |
|-----------------|--|
| <i>port</i>     | Master port to issue transaction                     |
| <i>local</i>    | Indicate a local master port or remote device access |
| <i>destid</i>   | Destination ID of the device                         |
| <i>hopcount</i> | Number of switch hops to the device                  |

## 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.



## 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)

## 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

|                 |  |
|-----------------|--|
| <i>port</i>     | Master port associated with the RIO network                              |
| <i>local</i>    | <code>local=1</code> select local port otherwise a far device is reached |
| <i>destid</i>   | Destination ID of the device to check host bit                           |
| <i>hopcount</i> | Number of hops to reach the target                                       |
| <i>port_num</i> | 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)

## 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

|                 |                                  |
|-----------------|----------------------------------|
| <i>mport</i>    | Master port to send transactions |
| <i>destid</i>   | Device destination ID in network |
| <i>hopcount</i> | Number of hops into the network  |

## 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.

## 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

|                 |  |
|-----------------|--|
| <i>port</i>     | Master port to issue transaction   |
| <i>local</i>    | Indicate a local master port or remote device access                             |
| <i>destid</i>   | Destination ID of the device   |
| <i>hopcount</i> | Number of switch hops to the device  |
| <i>from</i>     | Offset of current Extended Feature block header (if 0 starts from ExtFeaturePtr) |

## 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

|                 |  |
|-----------------|--|
| <i>port</i>     | Master port to issue transaction                     |
| <i>local</i>    | Indicate a local master port or remote device access |
| <i>destid</i>   | Destination ID of the device                         |
| <i>hopcount</i> | Number of switch hops to the device                  |
| <i>ftr</i>      | 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

## 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

|                |   |
|----------------|---|
| <i>vid</i>     | RIO vid to match or <code>RIO_ANY_ID</code> to match all vids                                   |
| <i>did</i>     | RIO did to match or <code>RIO_ANY_ID</code> to match all dids                                   |
| <i>asm_vid</i> | RIO <code>asm_vid</code> to match or <code>RIO_ANY_ID</code> to match all <code>asm_vids</code> |
| <i>asm_did</i> | RIO <code>asm_did</code> to match or <code>RIO_ANY_ID</code> to match all <code>asm_dids</code> |
| <i>from</i>    | Previous RIO device found in search, or <code>NULL</code> 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`.

## Name

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

## Synopsis

```
struct rio_dev * rio_get_device (ul6 vid, ul6 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`.



## 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

|                 |  |
|-----------------|--|
| <i>port</i>     | Master port to send transaction        |
| <i>destid</i>   | Destination ID for device/switch       |
| <i>hopcount</i> | Hopcount to reach switch               |
| <i>wait_ms</i>  | 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.

## 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

|                 |                                  |
|-----------------|----------------------------------|
| <i>port</i>     | Master port to send transaction  |
| <i>destid</i>   | Destination ID for device/switch |
| <i>hopcount</i> | Hopcount to reach switch         |

## Description

Returns 0 if device lock released or EINVAL if fails.

## 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

|                     |   |
|---------------------|---|
| <i>rdev</i>         | RIO device  |
| <i>table</i>        | Routing table ID  |
| <i>route_destid</i> | Destination ID to be routed                                     |
| <i>route_port</i>   | Port number to be routed  |
| <i>lock</i>         | apply a hardware lock on switch device flag (1=lock, 0=no_lock) |

## Description

If available calls the switch specific `add_entry` method to add a route entry into a switch routing table. Otherwise uses standard RT update method as defined by RapidIO specification. A specific routing table can be selected using the *table* argument if a switch has per port routing tables or the standard (or global) table may be used by passing `RIO_GLOBAL_TABLE` in *table*.

Returns 0 on success or `-EINVAL` on failure.

## Name

`rio_route_get_entry` — Read an entry from 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

|                     |   |
|---------------------|---|
| <i>rdev</i>         | RIO device  |
| <i>table</i>        | Routing table ID  |
| <i>route_destid</i> | Destination ID to be routed                                     |
| <i>route_port</i>   | Pointer to read port number into                                |
| <i>lock</i>         | apply a hardware lock on switch device flag (1=lock, 0=no_lock) |

## Description

If available calls the switch specific `get_entry` method to fetch a route entry from a switch routing table. Otherwise uses standard RT read method as defined by RapidIO specification. A specific routing table can be selected using the *table* argument if a switch has per port routing tables or the standard (or global) table may be used by passing `RIO_GLOBAL_TABLE` in *table*.

Returns 0 on success or `-EINVAL` on failure.

## Name

`rio_route_clr_table` — Clear a switch routing table

## Synopsis

```
int rio_route_clr_table (struct rio_dev * rdev, u16 table, int lock);
```

## Arguments

*rdev*   RIO device

*table*   Routing table ID

*lock*    apply a hardware lock on switch device flag (1=lock, 0=no\_lock)

## Description

If available calls the switch specific `clr_table` method to clear a switch routing table. Otherwise uses standard RT write method as defined by RapidIO specification. A specific routing table can be selected using the *table* argument if a switch has per port routing tables or the standard (or global) table may be used by passing `RIO_GLOBAL_TABLE` in *table*.

Returns 0 on success or `-EINVAL` on failure.

## Name

`rio_request_mport_dma` — request RapidIO capable DMA channel associated with specified local RapidIO mport device.

## Synopsis

```
struct dma_chan * rio_request_mport_dma (struct rio_mport * mport);
```

## Arguments

*mport*   RIO mport to perform DMA data transfers

## Description

Returns pointer to allocated DMA channel or NULL if failed.

## Name

`rio_request_dma` — request RapidIO capable DMA channel that supports specified target RapidIO device.

## Synopsis

```
struct dma_chan * rio_request_dma (struct rio_dev * rdev);
```

## Arguments

*rdev* RIO device associated with DMA transfer

## Description

Returns pointer to allocated DMA channel or NULL if failed.

## Name

`rio_release_dma` — release specified DMA channel

## Synopsis

```
void rio_release_dma (struct dma_chan * dchan);
```

## Arguments

*dchan* DMA channel to release



## Name

`rio_dma_prep_xfer` — RapidIO specific wrapper for `device_prep_slave_sg` callback defined by DMAENGINE.

## Synopsis

```
struct dma_async_tx_descriptor * rio_dma_prep_xfer (struct dma_chan
* dchan, ul6 destid, struct rio_dma_data * data, enum
dma_transfer_direction direction, unsigned long flags);
```

## Arguments

|                  |   |
|------------------|---|
| <i>dchan</i>     | DMA channel to configure                            |
| <i>destid</i>    | target RapidIO device destination ID                |
| <i>data</i>      | RIO specific data descriptor                        |
| <i>direction</i> | DMA data transfer direction (TO or FROM the device) |
| <i>flags</i>     | dmaengine defined flags                             |

## Description

Initializes RapidIO capable DMA channel for the specified data transfer. Uses DMA channel private extension to pass information related to remote target RIO device. Returns pointer to DMA transaction descriptor or NULL if failed.

## Name

`rio_dma_prep_slave_sg` — RapidIO specific wrapper for `device_prep_slave_sg` callback defined by DMAENGINE.

## Synopsis

```
struct dma_async_tx_descriptor * rio_dma_prep_slave_sg (struct rio_dev
* rdev, struct dma_chan * dchan, struct rio_dma_data * data, enum
dma_transfer_direction direction, unsigned long flags);
```

## Arguments

|                  |   |
|------------------|---|
| <i>rdev</i>      | RIO device control structure                        |
| <i>dchan</i>     | DMA channel to configure                            |
| <i>data</i>      | RIO specific data descriptor                        |
| <i>direction</i> | DMA data transfer direction (TO or FROM the device) |
| <i>flags</i>     | dmaengine defined flags                             |

## Description

Initializes RapidIO capable DMA channel for the specified data transfer. Uses DMA channel private extension to pass information related to remote target RIO device. Returns pointer to DMA transaction descriptor or NULL if failed.

## Name

`rio_register_scan` — enumeration/discovery method registration interface

## Synopsis

```
int rio_register_scan (int mport_id, struct rio_scan * scan_ops);
```

## Arguments

*mport\_id* mport device ID for which fabric scan routine has to be set (RIO\_MPORT\_ANY = set for all available mports)

*scan\_ops* enumeration/discovery operations structure

## Description

Registers enumeration/discovery operations with RapidIO subsystem and attaches it to the specified mport device (or all available mports if RIO\_MPORT\_ANY is specified).

Returns error if the mport already has an enumerator attached to it. In case of RIO\_MPORT\_ANY skips mports with valid scan routines (no error).

## Name

`rio_unregister_scan` — removes enumeration/discovery method from mport

## Synopsis

```
int rio_unregister_scan (int mport_id, struct rio_scan * scan_ops);
```

## Arguments

*mport\_id* mport device ID for which fabric scan routine has to be unregistered (RIO\_MPORT\_ANY = apply to all mports that use the specified scan\_ops)

*scan\_ops* enumeration/discovery operations structure

## Description

Removes enumeration or discovery method assigned to the specified mport device. If RIO\_MPORT\_ANY is specified, removes the specified operations from all mports that have them attached.

---

# Chapter 4. Internals

This chapter contains the autogenerated documentation of the RapidIO subsystem.

## Structures

## Name

struct rio\_switch — RIO switch info

## Synopsis

```
struct rio_switch {  
    struct list_head node;  
    u8 * route_table;  
    u32 port_ok;  
    struct rio_switch_ops * ops;  
    spinlock_t lock;  
    struct rio_dev * nextdev[0];  
};
```

## Members

|             |   |
|-------------|---|
| node        | Node in global list of switches                           |
| route_table | Copy of switch routing table                              |
| port_ok     | Status of each port (one bit per port) - OK=1 or UNINIT=0 |
| ops         | pointer to switch-specific operations                     |
| lock        | lock to serialize operations updates                      |
| nextdev[0]  | Array of per-port pointers to the next attached device    |

## Name

struct rio\_switch\_ops — Per-switch operations

## Synopsis

```
struct rio_switch_ops {
    struct module * owner;
    int (* add_entry) (struct rio_mport *mport, u16 destid, u8 hopcount, u16 table, u8 sw_domain);
    int (* get_entry) (struct rio_mport *mport, u16 destid, u8 hopcount, u16 table, u8 sw_domain);
    int (* clr_table) (struct rio_mport *mport, u16 destid, u8 hopcount, u16 table);
    int (* set_domain) (struct rio_mport *mport, u16 destid, u8 hopcount, u8 sw_domain);
    int (* get_domain) (struct rio_mport *mport, u16 destid, u8 hopcount, u8 *sw_domain);
    int (* em_init) (struct rio_dev *dev);
    int (* em_handle) (struct rio_dev *dev, u8 swport);
};
```

## Members

|            |  |
|------------|--|
| owner      | The module owner of this structure                             |
| 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 |

## Description

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

## 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;
    bool do_enum;
    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         |
| do_enum     | Enumeration flag                         |
| 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)             |

## 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 slot);  
};
```

## Members

|        |                        |
|--------|------------------------|
| res    | Mailbox resource       |
| mcback | Message event callback |

## 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, u16 info);
    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 |

## 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[RIO_MAX_MPORT_NAME];
    struct device dev;
    void * priv;
#ifdef CONFIG_RAPIDIO_DMA_ENGINE
    struct dma_device dma;
#endif
    struct rio_scan * nscan;
};
```

## 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[RIO_MAX_MPORT_NAME] | Port name string                                 |
| dev                      | device structure associated with an mport        |
| priv                     | Master port private data                         |
| dma                      | DMA device associated with mport                 |
| nscan                    | RapidIO network enumeration/discovery operations |

## Name

struct rio\_net — RIO network info

## Synopsis

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

## Members

|              |   |
|--------------|---|
| node         | Node in global list of RIO networks         |
| devices      | List of devices in this network             |
| switches     | List of switches in this network            |
| mports       | List of master ports accessing this network |
| hport        | Default port for accessing this network     |
| id           | RIO network ID                              |
| destid_table | destID allocation table                     |

## 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, u32 *data);
    int (* lcwrite) (struct rio_mport *mport, int index, u32 offset, int len, u32 data);
    int (* cread) (struct rio_mport *mport, int index, u16 destid, u8 hopcount, u32 *data);
    int (* cwrite) (struct rio_mport *mport, int index, u16 destid, u8 hopcount, u32 data);
    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, int entries);
    void (* close_outb_mbox) (struct rio_mport *mport, int mbox);
    int (* open_inb_mbox) (struct rio_mport *mport, void *dev_id, int mbox, int entries);
    void (* close_inb_mbox) (struct rio_mport *mport, int mbox);
    int (* add_outb_message) (struct rio_mport *mport, struct rio_dev *rdev, int mbox, void *buf);
    int (* add_inb_buffer) (struct rio_mport *mport, int mbox, void *buf);
    void *(* get_inb_message) (struct rio_mport *mport, int mbox);
    int (* map_inb) (struct rio_mport *mport, dma_addr_t lstart, u64 rstart, u32 size);
    void (* unmap_inb) (struct rio_mport *mport, dma_addr_t lstart);
};
```

## 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.        |
| map_inb          | Callback to map RapidIO address region into local memory space. |
| unmap_inb        | Callback to unmap RapidIO address region mapped with map_inb.   |

## 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.



## Name

struct rio\_scan — RIO enumeration and discovery operations

## Synopsis

```
struct rio_scan {  
    struct module * owner;  
    int (* enumerate) (struct rio_mport *mport, u32 flags);  
    int (* discover) (struct rio_mport *mport, u32 flags);  
};
```

## Members

|           |   |
|-----------|---|
| owner     | The module owner of this structure              |
| enumerate | Callback to perform RapidIO fabric enumeration. |
| discover  | Callback to perform RapidIO fabric discovery.   |

## Name

struct rio\_scan\_node — list node to register RapidIO enumeration and discovery methods with RapidIO core.

## Synopsis

```
struct rio_scan_node {  
    int mport_id;  
    struct list_head node;  
    struct rio_scan * ops;  
};
```

## Members

|          |  |
|----------|--|
| mport_id | ID of an mport (net) serviced by this enumerator |
| node     | node in global list of registered enumerators    |
| ops      | RIO enumeration and discovery operations         |

## Enumeration and Discovery

## Name

`rio_destid_alloc` — Allocate next available destID for given network

## Synopsis

```
ul6 rio_destid_alloc (struct rio_net * net);
```

## Arguments

*net*   RIO network

## Description

Returns next available device destination ID for the specified RIO network. Marks allocated ID as one in use. Returns `RIO_INVALID_DESTID` if new destID is not available.

## Name

`rio_destid_reserve` — Reserve the specivied destID

## Synopsis

```
int rio_destid_reserve (struct rio_net * net, u16 destid);
```

## Arguments

*net*       RIO network

*destid*   destID to reserve

## Description

Tries to reserve the specified destID. Returns 0 if successful.

## Name

`rio_destid_free` — free a previously allocated destID

## Synopsis

```
void rio_destid_free (struct rio_net * net, u16 destid);
```

## Arguments

*net*       RIO network

*destid*   destID to free

## Description

Makes the specified destID available for use.

## Name

`rio_destid_first` — return first destID in use

## Synopsis

```
u16 rio_destid_first (struct rio_net * net);
```

## Arguments

*net*   RIO network

## Name

`rio_destid_next` — return next destID in use

## Synopsis

```
u16 rio_destid_next (struct rio_net * net, u16 from);
```

## Arguments

*net*     RIO network

*from*   destination ID from which search shall continue

## 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

|                 |                          |
|-----------------|--------------------------|
| <i>port</i>     | RIO master port          |
| <i>destid</i>   | Destination ID of device |
| <i>hopcount</i> | Hopcount to device       |

## Description

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



## 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

|                 |                               |
|-----------------|-------------------------------|
| <i>port</i>     | RIO master port               |
| <i>destid</i>   | Destination ID of device      |
| <i>hopcount</i> | Hopcount to device            |
| <i>did</i>      | Device ID value to be written |

## Description

Writes the base/extended device id from a device.

## 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.

## Name

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

## Synopsis

```
int rio_clear_locks (struct rio_net * net);
```

## Arguments

*net*   RIO network to run on

## 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.

## 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.

## 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.

## 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.

## 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.

## 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

|                 |                                  |
|-----------------|----------------------------------|
| <i>net</i>      | RIO network                      |
| <i>port</i>     | Master port to send transactions |
| <i>destid</i>   | Current destination ID           |
| <i>hopcount</i> | Current hopcount                 |
| <i>do_enum</i>  | 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.



## 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

|                 |                                      |
|-----------------|--------------------------------------|
| <i>port</i>     | Master port to send transaction      |
| <i>destid</i>   | Associated destination ID for switch |
| <i>hopcount</i> | Hopcount to reach switch             |
| <i>sport</i>    | 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.

## 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.

## 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

|                  |   |
|------------------|---|
| <i>net</i>       | RIO network being enumerated                        |
| <i>port</i>      | Master port to send transactions                    |
| <i>hopcount</i>  | Number of hops into the network                     |
| <i>prev</i>      | Previous RIO device connected to the enumerated one |
| <i>prev_port</i> | Port on previous RIO device                         |

## Description

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

## 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 PGCCSR discovered bit for non-zero value (enumeration complete flag). Return 1 if enumeration is complete or 0 if enumeration is incomplete.

## 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

|                  |                                   |
|------------------|-----------------------------------|
| <i>net</i>       | RIO network being discovered      |
| <i>port</i>      | Master port to send transactions  |
| <i>destid</i>    | Current destination ID in network |
| <i>hopcount</i>  | Number of hops into the network   |
| <i>prev</i>      | previous <code>rio_dev</code>     |
| <i>prev_port</i> | previous port number              |

## Description

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

## 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.

## Name

`rio_alloc_net` — Allocate and configure a new RIO network

## Synopsis

```
struct rio_net * rio_alloc_net (struct rio_mport * port, int do_enum,  
                                ul6 start);
```

## Arguments

*port*        Master port associated with the RIO network

*do\_enum*    Enumeration/Discovery mode flag

*start*      logical minimal start id for new net

## 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.

## Name

`rio_update_route_tables` — Updates route tables in switches

## Synopsis

```
void rio_update_route_tables (struct rio_net * net);
```

## Arguments

*net*   RIO network to run update on

## Description

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



## 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).

## 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

## Name

`rio_enum_mport` — Start enumeration through a master port

## Synopsis

```
int rio_enum_mport (struct rio_mport * mport, u32 flags);
```

## Arguments

*mport*    Master port to send transactions

*flags*    Enumeration control flags

## 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.

## Name

`rio_build_route_tables` — Generate route tables from switch route entries

## Synopsis

```
void rio_build_route_tables (struct rio_net * net);
```

## Arguments

*net*   RIO network to run route tables scan on

## Description

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

## Name

`rio_disc_mport` — Start discovery through a master port

## Synopsis

```
int rio_disc_mport (struct rio_mport * mport, u32 flags);
```

## Arguments

*mport*    Master port to send transactions

*flags*    discovery control flags

## Description

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

## Name

`rio_basic_attach` —

## Synopsis

```
int rio_basic_attach ( void );
```

## Arguments

*void* no arguments

## Description

When this enumeration/discovery method is loaded as a module this function registers its specific enumeration and discover routines for all available RapidIO mport devices. The “scan” command line parameter controls ability of the module to start RapidIO enumeration/discovery automatically.

Returns 0 for success or -EIO if unable to register itself.

This enumeration/discovery method cannot be unloaded and therefore does not provide a matching `cleanup_module` routine.

## Driver functionality

## 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,
ul6 src, ul6 dst, ul6 info));
```

## Arguments

|               |   |
|---------------|---|
| <i>mport</i>  | RIO master port to bind the doorbell callback |
| <i>dev_id</i> | Device specific pointer to pass on event      |
| <i>res</i>    | Doorbell message resource                     |
| <i>dinb</i>   | 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.

## 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.



## 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

## 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

## 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

|                   |   |
|-------------------|---|
| <i>rdev</i>       | Pointer to RIO device control structure             |
| <i>pnum</i>       | Switch port number to clear errors                  |
| <i>err_status</i> | port error status (if 0 reads register from device) |

## 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

|                     |  |
|---------------------|--|
| <i>mport</i>        | Master port to issue transaction           |
| <i>destid</i>       | Destination ID of the device               |
| <i>hopcount</i>     | Number of switch hops to the device        |
| <i>table</i>        | routing table ID (global or port-specific) |
| <i>route_destid</i> | destID entry in the RT                     |
| <i>route_port</i>   | destination port for specified destID      |

## 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

|                     |  |
|---------------------|--|
| <i>mport</i>        | Master port to issue transaction               |
| <i>destid</i>       | Destination ID of the device                   |
| <i>hopcount</i>     | Number of switch hops to the device            |
| <i>table</i>        | routing table ID (global or port-specific)     |
| <i>route_destid</i> | destID entry in the RT                         |
| <i>route_port</i>   | returned destination port for specified destID |

## Name

`rio_std_route_clr_table` — Clear switch 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

|                 |  |
|-----------------|--|
| <i>mport</i>    | Master port to issue transaction           |
| <i>destid</i>   | Destination ID of the device               |
| <i>hopcount</i> | Number of switch hops to the device        |
| <i>table</i>    | routing table ID (global or port-specific) |

## Name

`rio_find_mport` — find RIO mport by its ID

## Synopsis

```
struct rio_mport * rio_find_mport (int mport_id);
```

## Arguments

*mport\_id*    number (ID) of mport device

## Description

Given a RIO mport number, the desired mport is located in the global list of mports. If the mport is found, a pointer to its data structure is returned. If no mport is found, `NULL` is returned.

## Name

`rio_mport_scan` — execute enumeration/discovery on the specified mport

## Synopsis

```
int rio_mport_scan (int mport_id);
```

## Arguments

*mport\_id*    number (ID) of mport device



## 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.

## 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.

## 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.

## 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.

## Device model support

## 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.

## 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

## 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.

## 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.



## 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 mport device class and RIO bus type with the Linux device model.

## Sysfs support

## 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.

## 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.

## PPC32 support

## 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

|               |  |
|---------------|--|
| <i>mport</i>  | RapidIO master port info                         |
| <i>index</i>  | ID of RapdiIO interface                          |
| <i>offset</i> | Offset into configuration space                  |
| <i>len</i>    | Length (in bytes) of the maintenance transaction |
| <i>data</i>   | Value to be read into                            |

## Description

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

## 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

|               |  |
|---------------|--|
| <i>mport</i>  | RapidIO master port info                         |
| <i>index</i>  | ID of RapidIO interface                          |
| <i>offset</i> | Offset into configuration space                  |
| <i>len</i>    | Length (in bytes) of the maintenance transaction |
| <i>data</i>   | Value to be written                              |

## Description

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

## 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

|                 |  |
|-----------------|--|
| <i>mport</i>    | RapidIO master port info                         |
| <i>index</i>    | ID of RapdiIO interface                          |
| <i>destid</i>   | Destination ID of transaction                    |
| <i>hopcount</i> | Number of hops to target device                  |
| <i>offset</i>   | Offset into configuration space                  |
| <i>len</i>      | Length (in bytes) of the maintenance transaction |
| <i>val</i>      | Location to be read into                         |

## Description

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

## 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

|                 |  |
|-----------------|--|
| <i>mport</i>    | RapidIO master port info                         |
| <i>index</i>    | ID of RapdiIO interface                          |
| <i>destid</i>   | Destination ID of transaction                    |
| <i>hopcount</i> | Number of hops to target device                  |
| <i>offset</i>   | Offset into configuration space                  |
| <i>len</i>      | Length (in bytes) of the maintenance transaction |
| <i>val</i>      | Value to be written                              |

## Description

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

## 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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