LINUX on zSeries

HiperSockets Support- October 31, 2001

LINUX kernel 2.4

LNUX-2004-01

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Note

Before using this document, be sure to read the information in “Notices” on page 21.

Second Edition – (October 2001)

This edition applies to the LINUX on zSeries kernel 2.4 patch (made in September 2001).

This edition replaces LNUX-2004-00.

Contents

About this book

This book describes how to configure the QETH module for LINUX on zSeries HiperSockets. Feedback on this topic can be sent to:

`Linux390@de.ibm.com`

The driver described herein has been developed for the zSeries 64-bit architecture and 31-bit architecture with version 2.4 of the LINUX kernel.

Assumptions

The following general assumptions are made about your background knowledge:

- You have an understanding of LINUX and zSeries terminology.
- You are familiar with LINUX device driver software.
- You have an understanding of basic computer architecture, operating systems, and programs.
- You are familiar with the devices attached to your system. (Detailed knowledge should not be required, as the code specific to the hardware is provided by IBM.)

Chapter 1. LINUX on zSeries QETH device driver for HiperSockets

This driver is subject to licence conditions as reflected in: “International License Agreement for Non-Warranted Programs” on page 23.

The QETH LINUX network driver supports HiperSockets virtual devices as well as the OSA-Express feature in QDIO mode on Fast Ethernet, Gigabit Ethernet and High Speed Token Ring. HiperSockets enable the zSeries to connect to virtual networks on a shared zSeries.

A HiperSockets device is controlled by the same device driver as the OSA-Express card. Most of the device driver parameters are common to the two devices.

The OSA-Express card is described in detail in *OSA-Express Customer’s Guide and Reference*, SA22-7403.

Naming conventions

Different cards used will generate different interface base names:

- Ethernet cards will generate an interface name starting with ″eth″
- Token Ring cards will generate an interface name starting with ″tr″
- HiperSockets devices will generate an interface name starting with ″hsi″

Numbers will be appended to the base names according to the following rules:

- If a device interface number, `devif_num`, is specified during device configuration, that number will be used. For example, a device configuration like:

  ```
  qeth7, <read_devno>, <write_devno>, <data_devno>
  ```

  will cause the interface name to be `eth7` for an Ethernet card, `tr7` for a Token Ring card, and `hsi7` for HiperSockets.

  If the `devif` number is `-1`, the next available number will be used. See “Configuring QETH for HiperSockets using the channel device layer” on page 2 for the description of `devif_num`.
- If chandev is instructed to use device number names (`use_devno_names`), the interface number will be the cuu number of the read channel. For example, if the read channel has the cuu `0xfd0c`, the interface name would be `eth0xfd0c` for an Ethernet card, `tr0xfd0c` for a Token Ring card, and `hsi0xfd0c` for a HiperSockets device. See “Commonly used options” on page 13 for the description of `use_devno_names`.

Introduction

You need two modules to configure HiperSockets as well as the OSA-Express feature in QDIO mode:

- The QDIO protocol governs the interface between the zSeries and the OSA-Express card. You need only load the QDIO module, no configuration is necessary.
- The QETH module controls the card itself. How to configure the QETH module is described in this chapter.

For HiperSockets three I/O subchannels must be available to the driver. One subchannel is for control reads, one for control writes, and the third is for data.

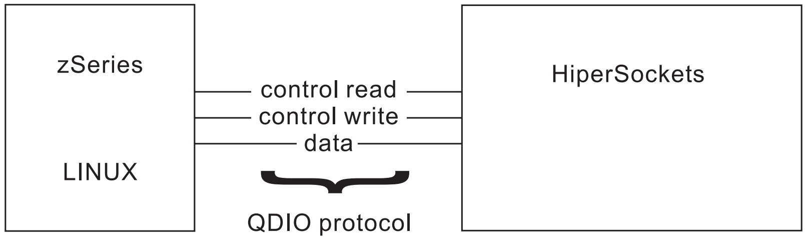


Figure 1. Channels and devices

QETH supported functions

The following functions are supported:

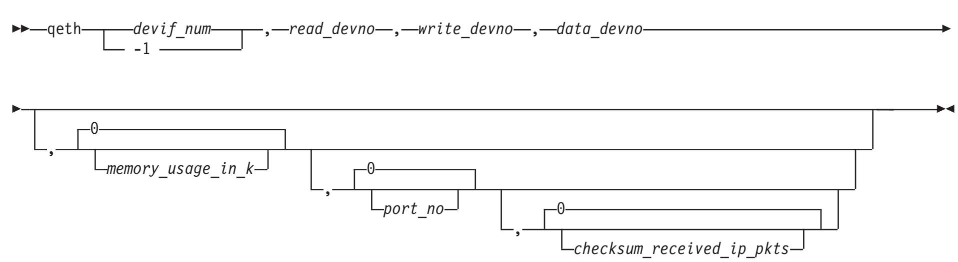
- Auto-detection of devices
- Primary and secondary routers
- Individual device configuration. It is possible to configure different triples of channels on the same CHPID differently. For example, if you have CHPID fc, then you can configure 0xfc00,0xfc01,0xfc02 differently from 0xfc04,0xfc05,0xfc06, for example, with different mem_usage values.
- IP Address Takeover

Configuring QETH for HiperSockets using the channel device layer

This section describes how to configure QETH for HiperSockets with the channel device layer. Only the most common options are given here to illustrate the syntax; see “Chapter 2. LINUX on zSeries Channel device layer” on page 11 for full details of all channel device options.

The driver will normally use auto-detection to find all HiperSockets in the system. (The `noauto` option can be used to exclude address ranges from auto-detection.) In some circumstances it may be necessary to configure the driver explicitly for a device. This is done with the command:

HiperSockets device identification



Note: All characters must be entered in lower case as shown, except in hexadecimal numbers where either case may be used.

Where:

devif_num
: is the device interface number. This is concatenated with `qeth`, for example `qeth1`.

  A value of -1 indicates that the next available number is to be allocated automatically.

read_devno
: is the read channel address (in hexadecimal preceded by 0x)

  This address must be an even number.

write_devno
: is the write channel address (in hexadecimal preceded by 0x)

  This address must be one greater than the read channel address.

data_devno
: is the data channel address (in hexadecimal preceded by 0x)

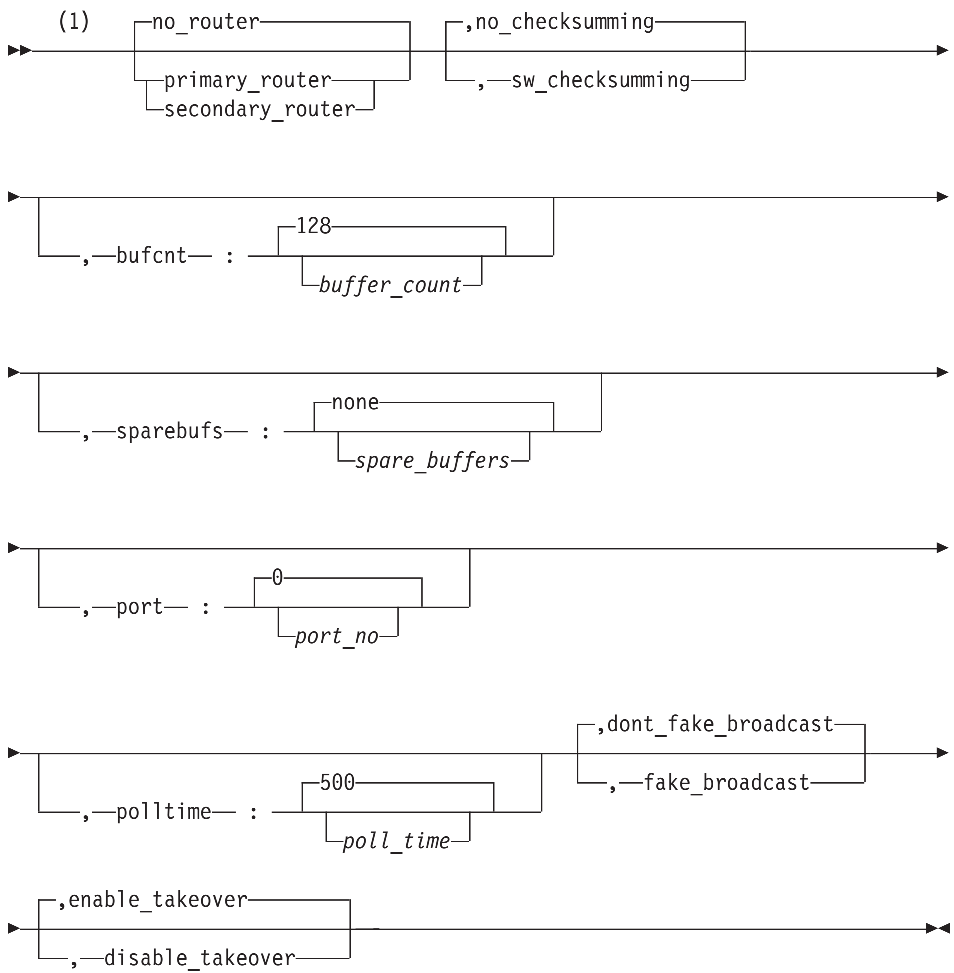
memory_usage_in_k
: is the number of kilobytes to be allocated for read and write buffers. (The allocation between read and write is determined by the driver.)

port_no
: is the relative port number of the device.

checksum_received_ip_pkts
: is 1 to perform software checksumming or 0 (the default) not to perform it.

HiperSockets QETH parameter syntax

qeth options



Notes:

1 All options except the first used must be preceded by a comma. All characters must be entered in lower case as shown, except in hexadecimal numbers where either case may be used.

The meanings of the parameters of this command are as follows:

primary_router | secondary_router | no_router

Specifies whether the device is used to interconnect networks. A ″Primary router″ is the principal connection between two networks; a ″Secondary router″ is used as backup in case of problems with the primary. Both of these options require the LINUX system to be configured as a router. The default for this parameter is ″No router″ – the HiperSockets will only be used to connect the LINUX on zSeries system to a single network.

It is possible to add routing status dynamically. This is done with the command:

```
echo primary_router ifname > /proc/qeth
```

or

```
echo secondary_router ifname > /proc/qeth
```

| *ifname* is the name of the interface in LINUX, for example `hsi0`.

It is not possible to reset routing status with the current hardware.

sw_checksumming | no_checksumming
Specifies whether error detection is to be performed by the driver, or is not required.

buffer_count
Specifies the number of inbound buffers used. Valid values for *buffer_count* are 16 to 128. The default is 128.

This may be used to overcome problems with memory shortage. The size of each buffer is 64 kilobytes.

spare_buffers
Specifies the number of spare buffers to reserve. The default is none. These buffers are pre-allocated and can be used as a safety valve if excessive load fills the normal buffer pool.

port_no
Specifies the port number on the `CHPID`. The default port number is 0.

poll_time
Specifies the maximum duration of background polling (in microseconds) used by `QDIO`. The default is 500.

dont_fake_broadcast | fake_broadcast
`fake_broadcast` sets the 'broadcast capable' device flag. This is necessary for the `gated` routing daemon.

enable_takeover | disable_takeover
allow/do not allow IP address takeover.

HiperSockets channel device layer configuration example

|

```
qeth1,0x7c00,0x7c01,0x7c02,4096,-1
```

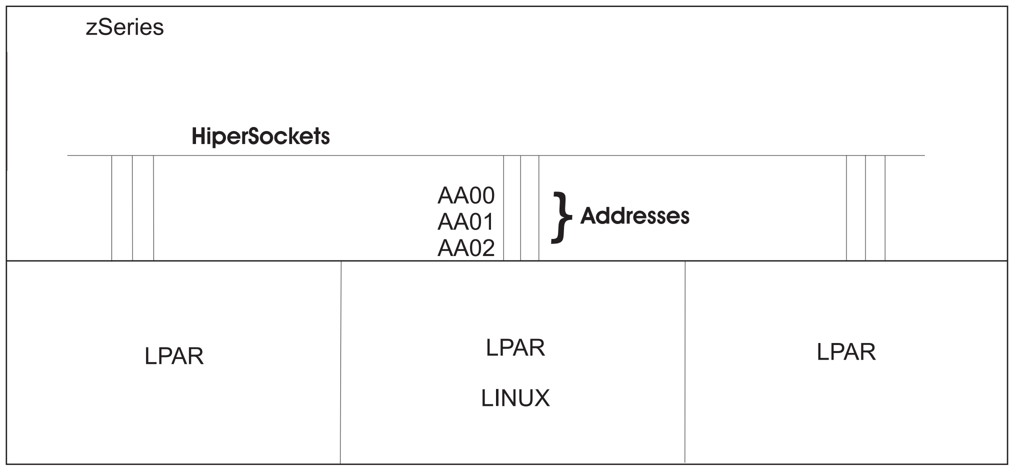
| This tells the channel device layer to force `qeth1` (if detected) to use device addresses 7c00, 7c01 and 7c02, allocate four megabytes of buffer space, and use the default port.

HiperSockets examples

1: Basic configuration

In this example a single HiperSockets is being used to connect a LINUX on zSeries system to a network.

Hardware configuration – HiperSockets connecting LINUX on zSeries to a network.



Software configuration – HiperSockets connecting LINUX on zSeries to a network.

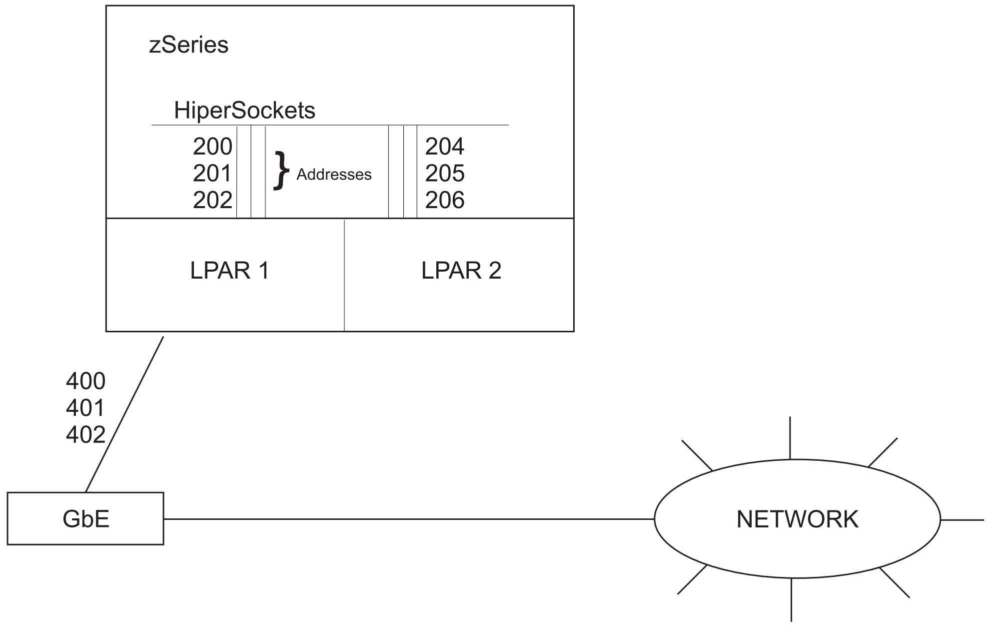
With the channel device layer the load commands for this configuration are:

```
qeth-1,0xAA00,0xAA01,0xAA02
```

2: Router configuration

This example shows how LINUX systems running on different LPARs in a zSeries may use HiperSockets to communicate with a network or to act as a router between networks.

Hardware configuration – HiperSockets and LINUX on zSeries as router.



In this example it is assumed that LINUX is configured as a router in both LPARs.

Software configuration – HiperSockets and LINUX on zSeries as router.

LPAR 1 – uses subchannels 200 - 202 for connecting to HiperSockets and 400 - 402 to connect to the OSA-Express feature. There it is able to route packets in and out. Specifying `primary_router` for HiperSockets is in general not necessary:

```
add_parms,0x10,0x400,0x402,primary_router
qeth-1,0x400,0x401,0x402
qeth-1,0x200,0x201,0x202
```

LPAR 2 – uses subchannels 204 - 206 as a network client:

```
qeth-1,0x204,0x205,0x206
```

HiperSockets – Preparing the connection

Activating the HiperSockets connection

The network devices can be activated with the `ifconfig` command. The right MTU size is selected automatically.

For details of the ifconfig command, see the ifconfig manpage.

An example of the use of `ifconfig` is:

```
ifconfig hsi0 192.168.100.11 netmask 255.255.255.0
```

HiperSockets IP Address Takeover

Unless the `disable_takeover` flag has been set it is possible to add and remove ranges of IP addresses for HiperSockets by writing to the `/proc/qeth_ipa_takeover` file. When a command is written to this file the driver calls on the OSA ″Address Takeover″ mechanism. This overrides any previous allocation of the specified address to another LPAR or card. If another LPAR on the same card has already registered for that IP address this association will be removed.

Note: Using HiperSockets, only IP addresses of another LINUX operating system in the same CEC can be taken over, not IP addresses of other zSeries operating systems. IP takeover must be enabled both on the image taking over the address, and on the image that gives up its address.

The registered addresses are held in this file in plain text and can be read to see the current associations.

Only one command at a time can be written to the file. Subsequent commands in the same write action are ignored.

The following commands are available:
- `add4` *<addr>*/*<mask_bits>*[:*<interface>*]
- `inv4`
- `del4` *<addr>*/*<mask_bits>*[:*<interface>*]

`add4` adds an address range. `del4` deletes an address range. *<addr>* is an 8 character hexadecimal IP address. *<mask_bits>* specifies the number of bits which are set in the network mask. *<interface>* is optional and specifies the interface name to which the address range is bound.

For example

```
echo add4 c0a80a00/24 > /proc/qeth_ipa_takeover
```

activates all addresses in the 192.168.10 subnet for address takeover.

`inv4` inverts the selection of address ranges done with add4. Issue `inv4` once to set all addresses which have been specified with `add4` not to use the takeover mechanism; all other IPv4 addresses will be set to use it.

Note that the address is not actually taken over until a corresponding `ifconfig` command is executed; for example

```
ifconfig hsi0 192.168.10.5
```

sets the IP address 192.168.10.5 on the device `hsi0`, and removes it from other LPARs if necessary.

The IP address must be different to that previously set on the device or no action will be taken. To take over a device at the same address `ifconfig` must be called twice; the first time with a dummy address (for example 0.0.0.0) to notify the device of the takeover and the second time with the original address to reset it. To re-capture the `hsi0` device with the IP address in the previous example you could use:

```
ifconfig hsi0 0.0.0.0
ifconfig hsi0 192.168.10.5
```

The second line alone will not take over the device from another LPAR if the IP address is the same as that set by the other LPAR.

QETH restrictions

- The MTU range is 576 – 57344. This may be restricted by the framesize announced by the microcode.
- There is a restriction in LINUX that the packet size of a multicast packet can not be greater than the MTU size of the interface used.

Chapter 2. LINUX on zSeries Channel device layer

The channel device layer provides a common interface to LINUX on zSeries channel devices. You can use this interface to configure the devices and to handle machine checks (devices appearing and disappearing).

The drivers using the channel device layer at the time of writing are:

1. **LCS** – Ethernet, Token Ring, non-QDIO OSA
2. **CTC/ESCON** – high speed serial link
3. **QETH** – OSA-Express feature in QDIO mode and HiperSockets.

The *raison d'être* of the channel device layer is to draw together the configuration of the drivers and to resolve conflicts. These could, for example, result in the `LCS` and `CTC` drivers fighting over 3088/08 and 3088/1F devices (which could be either 2216/3172 `LCS` compatible devices or `ESCON/CTC`). To resolve the clashing without the channel device layer each of these device drivers had to be configured separately, with a check for conflicts performed by eye.

The channel device layer is used on a per-driver basis, not on a system basis. For example a CTC driver which is not configured to use the channel device layer can be used in conjunction with a LCS driver which is configured to use it.

Description

The current configuration of the channel device layer is held (in human readable form) in the file `/proc/chandev`.

You can pass arguments to the channel device layer in three ways:

1. Piping them to `/proc/chandev`, for example:

   ```
   echo reprobe >/proc/chandev
   ```

   will cause un-initialized channel devices to be probed.
2. Editing them into `/etc/chandev.conf` – this will only take effect after a reboot of after executing the sequence of commands mentioned in "Read configuration" on page 18.
3. Using the `'chandev='` keyword on the LINUX boot command line, for example:

   ```
   chandev=noauto,0x0,0x480d;noauto,0x4810,0xffff
   ```

   will exclude all devices from auto-detection except for subchannels 0x480e and 0x480f.

Multiple options can be passed, separated by commas, but no spaces are allowed between parameters. You can also add comments to the configuration file. Comment lines must be prefixed with a '#' character.

To be consistent with other hotpluggable architectures the script pointed to by `/proc/sys/kernel/hotplug` (this will normally be `/sbin/hotplug`) will be called automatically on startup or on a device machine check as follows:.

```
/sbin/hotplug chandev <start starting_devnames>
                      <machine_check (devname last/pre_recovery_status)
                                     (current/post_recovery_status)>.
```

The channel device layer does not open stdin stdout or stderr so it is advisable that you open them at the start of your script, as in this sample which starts devices as they become available:

```
#!/bin/bash
exec >/dev/console 2>&1 0>&1
# Remove the comment symbol from the line below for debugging purposes.
# echo $*
if [ "$1" = "chandev" ] && [ "$2" = "start" ]
then
    shift 2
    while [ "$1" != "" ]  && [ "$1" != "machine_check" ]
    do
        isup='ifconfig $1 2>/dev/null | grep UP'
        if [ "$isup" = "" ]
        then
            ifup $1
        fi
        shift
    done
fi
```

For example if devices tr0 and ctc0 become active at a time when eth0 and eth1 are subject to a gone machine check and eth2 is subject to a revalidate machine check (which is normally fully recoverable) the parameters passed to hotplug would be:

```
/sbin/hotplug chandev start tr0 ctc0
                  machine_check eth0 gone gone eth1 gone gone
                                eth2 revalidate good
```

This script can be used, for example, to call /etc/rc.d/init.d/network start when a device appears. (This makes the ipldelay kernel boot parameter obsolete when LINUX is running native.) It may also be used to recover from bad machine checks if the default machine check handling is inadequate. The machine checks that can be presented as parameters to the channel device layer are good, not_operational, no_path, revalidate and device_gone.

The channel device layer will wait a few seconds after machine checks before running /sbin/hotplug because a machine check on one device is often followed by checks on others. It is better to handle multiple devices with a single script, rather than with individual scripts for each device which could compete for resources.

Channel device layer options

Terminology

devno a 16 bit unsigned number (usually expressed as hexadecimal) which uniquely identifies a subchannel connected to a device.

force list
a term (specific to channel device layer) describing a range of *devno* which are to be configured specifically (as opposed to configuration by auto-detection).

auto machine check recovery bitfield

The bits in this field signify:

not_operational
0x1

no_path
0x2

revalidate
0x4

gone 0x8

chan_type bitfield

The bits in this field signify:

ctc 0x01

escon 0x02

lcs 0x04

osad 0x08 – reserved, not used in this release

qeth 0x10

A single device driver may handle more than one type of device. In this case the values corresponding to each device handled are summed to create the parameter

Device identification (QDIO)

For the syntax of the HiperSockets with the channel device layer see “Configuring QETH for HiperSockets using the channel device layer” on page 2.

Commonly used options

These options are used to set up the system.

add parameters

```
►►─add_parms─,─chan_type─┬──────────────────────────┬─,─string──────►◄
                         └─,─lo_devno─,─high_devno─┘
```

chan_type is defined in ***chan_type bitfield*** in the terminology on page 13.

This is for device driver specific options which are passed as a string to the driver and are not dealt with by the channel device layer. This string cannot contain spaces. ***lo_devno*** and ***high_devno*** are optional parameters to specify a range.

The *string* is interpreted by the driver (see the particular driver chapter for details).

delete parameters

```
►►─del_parms─┬──────────────────────────────────────────┬──────►◄
             └─,─chan_type─┬──────────────────────────┬─┘
                           └─,─exact_match─┬────────┬─┘
                                           └─,─lo_devno─┘
```

chan_type is defined in the terminology on page 13.

This deletes some or all device driver specific options. If `chan_type` is not specified all the strings will be deleted. If ***exact_match*** is set to '1' the driver parameters will only be removed where ***chan_type*** is exactly equal. If ***exact_match*** is set to '0' the parameters are to be removed where any bit matches ***chan_type***. ***lo_devno*** is an optional parameter to specify that the delete is only to happen if this parameter matches a ***lo_devno*** in a defined range.

no auto-detection

```
►►──noauto──┬──────────────────────────────┬──────────────────────────►◄
            └─,──lo_devno──,──high_devno───┘
```

This stops auto-detection of channel devices in the given range of device numbers. `noauto` without a device range will stop auto-detection of all channel devices.

use device names

```
►►──use_devno_names──────────────────────────────────────────────────►◄
```

This instructs the channel device layer to assign device names based on the `cuu` number of the read channel. For example a token ring read channel with `cuu` number 0x7c00 would be assigned an interface name of `tr0x7c00`. This may be used to avoid device name conflicts. The default is to generate device names in sequence, so the default name for the channel above might be `tr2`.

Power user options

These options are used for maintenance or fine-tuning.

delete no-auto ranges

```
►►──del_noauto──┬────────────┬───────────────────────────────────────►◄
                └─,──devno───┘
```

Delete the range containing `devno`, or all `noauto` ranges if `devno` is not given.

delete forced device

```
►►──del_force──,──read_devno─────────────────────────────────────────►◄
```

Remove a forced channel device from the force list.

do not use device names

```
►►—dont_use_devno_names——————————————————————————————————————►◄
```

Cancel a **use_devno_names** command.

add a device

```
►►—add_model—,—chan_type—,—cu_type—,—cu_model—,—dev_type—,—dev_model—,——►

►—max_port_no—,—automatic_machine_check_handling——————————————————————►◄
```

Probe for the device specified. '-1' may be used as a wildcard for any of the parameters except ***chan_type*** or ***automatic_machine_check_handling***. Set ***max_port_no*** to zero ('0') for non LCS devices.

chan_type and ***automatic_machine_check_handling*** are defined in the terminology on page 12.

delete a device

```
►►—del_model—,—cu_type—,—cu_model—,—dev_type—,—dev_model——————————►◄
```

Remove the device specified. '-1' may be used as a wildcard for any of the parameters.

delete all devices

```
►►—del_all_models————————————————————————————————————————————►◄
```

Remove all devices.

auto-detect any devices

```
►►—non_cautious_auto_detect——————————————————————————————————►◄
```

Attempt to auto-detect devices even if their type/model pairs do not unambiguously identify the device. For example 3088/1F's can either be `CTC/ESCON` or `3172 LCS` compatible devices. If the wrong device driver attempts to probe these channels there may be long delays on startup or even a kernel lockup, so use this option with caution.

auto-detect known devices

```
►►──cautious_auto_detect──────────────────────────────────────────────►◄
```

Do not attempt to auto-detect devices unless their type/model pairs unambiguously identify the device. (This is the default behavior.)

machine check recovery

```
►►──auto_msck──┬──────────────────────────────┬─,──auto_msck_recovery──────►◄
               └─,──lo_devno──,──high_devno───┘
```

Specify the kind of machine check recovery to be performed over a range of devices. ***auto_msck_recovery*** is defined in the terminology on page 12.

delete machine check recovery

```
►►──del_auto_msck──┬────────────┬──────────────────────────────────►◄
                   └─,──devno───┘
```

Delete machine check recovery for the range of devices including ***devno***, or all machine check recovery if ***devno*** is not specified.

null model information

```
►►──reset_clean───────────────────────────────────────────────────►◄
```

Reset all model information, forced devices and `noauto` lists to null.

default model information

```
►►──reset_conf──────────────────────────────────────────────────►◄
```

Reset all model information, forced devices and `noauto` lists to default settings.

empty model information

```
►►──reset_conf_clean────────────────────────────────────────────►◄
```

Reset all model information, forced devices and `noauto` lists to empty.

shutdown device

```
►►──shutdown──┬─────────────────┬───────────────────────────────►◄
              └─┬─device_name─┬─┘
                └─read_devno──┘
```

Shut down the particular device identified by ***device_name*** or ***read_devno***, de-register it and release its interrupts. If no parameter is given all devices are shut down.

reprobe

```
►►──reprobe─────────────────────────────────────────────────────►◄
```

Call probe method for channels whose interrupts are not owned.

unregister general probe

```
►►──unregister_probe──┬────────────────┬────────────────────────►◄
                      └─probefunc_addr─┘
```

Unregister a probe function, or unregister all probe functions if no address given.

unregister specific probe

```
►►—unregister_probe_by_chan_type—chan_type—————————————————►◄
```

Unregister all probe functions which match the `chan_type` bitfield exactly. This is useful if you want a configuration to survive a kernel upgrade.

read configuration

```
►►—read_conf———————————————————————————————————————————————►◄
```

Read instructions from `/etc/chandev.conf`.

This is used to make the channel device layer read from `/etc/chandev.conf` on boot, or to cause the channel device layer to re-read its configuration during operation.

do not read configuration

```
►►—dont_read_conf——————————————————————————————————————————►◄
```

Do not read instructions from `/etc/chandev.conf` on boot.

For example the following sequence of commands piped to `/proc/chandev` should have the same effect as rebooting for channel devices:

- `shutdown`
- `reset_conf`
- `read_conf`
- `reprobe`

See also

If you wish to write a driver which is compatible with the channel device layer see:

- `/linux/include/asm-s390/chandev.h` – for the API (which is commented), and
- `/linux/drivers/s390/misc/chandev.c` – for the code.

Files

/proc/chandev
This holds the current configuration. Use

```
cat /proc/chandev
```

to see the configuration, and

```
echo command >/proc/chandev
```

to enter a new command.

/etc/chandev.conf
This file can be used to configure the channel device layer kernel parameters.

/sbin/hotplug
This is a user script or executable which is run whenever devices come online or go offline ('appear' or 'disappear').

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