Writing s390 channel device drivers

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Introduction

This document describes the interfaces available for device drivers that drive s390 based channel attached I/O devices. This includes interfaces for interaction with the hardware and interfaces for interacting with the common driver core. Those interfaces are provided by the s390 common I/O layer.

The document assumes a familarity with the technical terms associated with the s390 channel I/O architecture. For a description of this architecture, please refer to the "z/Architecture: Principles of Operation", IBM publication no. SA22-7832.

While most I/O devices on a s390 system are typically driven through the channel I/O mechanism described here, there are various other methods (like the diag interface). These are out of the scope of this document.

The s390 common I/O layer also provides access to some devices that are not strictly considered I/O devices. They are considered here as well, although they are not the focus of this document.

Some additional information can also be found in the kernel source under Documentation/s390/driver-model.rst.

The css bus

The css bus contains the subchannels available on the system. They fall into several categories:

- Standard I/O subchannels, for use by the system. They have a child device on the ccw bus and are described below.
- I/O subchannels bound to the vfio-ccw driver. See Documentation/s390/vfio-ccw.rst.
- Message subchannels. No Linux driver currently exists.
- CHSC subchannels (at most one). The chsc subchannel driver can be used to send asynchronous chsc commands.
- eADM subchannels. Used for talking to storage class memory.

The ccw bus

The ccw bus typically contains the majority of devices available to a s390 system. Named after the channel command word (ccw), the basic command structure used to address its devices, the ccw bus contains so-called channel attached devices. They are addressed via I/O subchannels, visible on the css bus. A device driver for channel-attached devices, however, will never interact with the subchannel directly, but only via the I/O device on the ccw bus, the ccw device.

I/O functions for channel-attached devices

Some hardware structures have been translated into C structures for use by the common I/O layer and device drivers. For more information on the hardware structures represented here, please consult the Principles of Operation.

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```
.. kernel-doc:: arch/s390/include/asm/cio.h
   :internal:
```

ccw devices

Devices that want to initiate channel I/O need to attach to the ccw bus. Interaction with the driver core is done via the common I/O layer, which provides the abstractions of ccw devices and ccw device drivers.

The functions that initiate or terminate channel I/O all act upon a ccw device structure. Device drivers must not bypass those functions or strange side effects may happen.

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```
.. kernel-doc:: arch/s390/include/asm/ccwdev.h
   :internal:
```

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```
.. kernel-doc:: drivers/s390/cio/device.c
   :export:
```

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```
.. kernel-doc:: drivers/s390/cio/device_ops.c
   :export:
```

The channel-measurement facility

The channel-measurement facility provides a means to collect measurement data which is made available by the channel subsystem for each channel attached device.

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```
.. kernel-doc:: arch/s390/include/uapi/asm/cmb.h
   :internal:
```

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```
.. kernel-doc:: drivers/s390/cio/cmf.c
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```

The ccwgroup bus

The ccwgroup bus only contains artificial devices, created by the user. Many networking devices (e.g. qeth) are in fact composed of several ccw devices (like read, write and data channel for qeth). The ccwgroup bus provides a mechanism to create a meta-device which contains those ccw devices as slave devices and can be associated with the netdevice.

ccw group devices

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```
.. kernel-doc:: arch/s390/include/asm/ccwgroup.h
   :internal:
```

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```
.. kernel-doc:: drivers/s390/cio/ccwgroup.c
```

```
   :export:
```

Generic interfaces

The following section contains interfaces in use not only by drivers dealing with ccw devices, but drivers for various other s390 hardware as well.

Adapter interrupts

The common I/O layer provides helper functions for dealing with adapter interrupts and interrupt vectors.

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```
.. kernel-doc:: drivers/s390/cio/airq.c
   :export:
```