

# ***Rockchip***

## ***Linux HDMI CEC Developer Guide***

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Fuzhou Rockchip Electronics Co., Ltd

Address: No.18 Building, A District, No.89 Software Boulevard, FuZhou, FuJian, PRC

Website: [www.rock-chips.com](http://www.rock-chips.com)

Customer service Tel.: +86-591-83991906

Customer service Fax: +86-591-83951833

Customer service e-Mail: [fae@rock-chips.com](mailto:fae@rock-chips.com)

# **Preface**

## **Overview**

This document mainly introduces Rockchip Linux SDK HDMI CEC, including how to enable it, related commands, and considerations.

## **Product version**

<b>Chipset</b>	<b>Kernel version</b>
RK3288	4.4
RK3399	4.4

## **Applicable to object**

This document is mainly suitable for below engineers:

- Field Application Engineer
- Software Development Engineer

## **Revision history**

<b>Date</b>	<b>Version</b>	<b>Author</b>	<b>Revision Description</b>
2019.04.09	V1.0	Nickey Yang	Initial version
2019.06.24	V1.1	Ruby Zhang	Update Customer service e-Mail and fix related commands in chapter 2.4.2

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# 1 CEC Introduction

## 1.1 CEC Overview

CEC is short for Consumer Electronics Control. CEC is an optional feature in HDMI protocol. It is designed to provide advanced control for all home audio-visual devices connected via HDMI in the same user environments, allowing users to command and control these connected devices via a remote control. CEC is a two-way, single-bus protocol that allows each CEC-enabled device to command and control each other.

## 1.2 CEC Introduction

It is supposed that all audio and video sources in a system are directly or indirectly connected to a "root" display device and formed a top-down tree by a HDMI cable, and the display device acts as a "root", signal switching device as a "branch", different signal source products act as "leaves" nodes.

In order to address and control devices with specific physical address, there should be physical addresses in all devices in the system. The CEC protocol assigns physical addresses to all devices in the network through EDID. There should be one and only one physical address in each device.

Each device connected to the CEC control bus should be bound to a logical address that defines the type of device. Only one device can be bound to each logical address (except 15). Most devices are bound to only one logical address, and a few devices can bind two logical addresses.

Address	Device
0	TV
1	Recording Device 1
2	Recording Device 2
3	Tuner 1
4	Playback Device 1
5	Audio System
6	Tuner 2
7	Tuner 3
8	Playback Device 2
9	Recording Device 3
10	Tuner 4
11	Playback Device 3
12	Reserved
13	Reserved
14	Specific Use
15	Unregistered (as Initiator address) Broadcast (as Destination address)

Figure 1-1 CEC Logical address

Figure 1-2 shows the process of binding a logical address. Whether the address is already occupied by other devices can be confirmed by sending “poll MSG” with the same src and dst address.

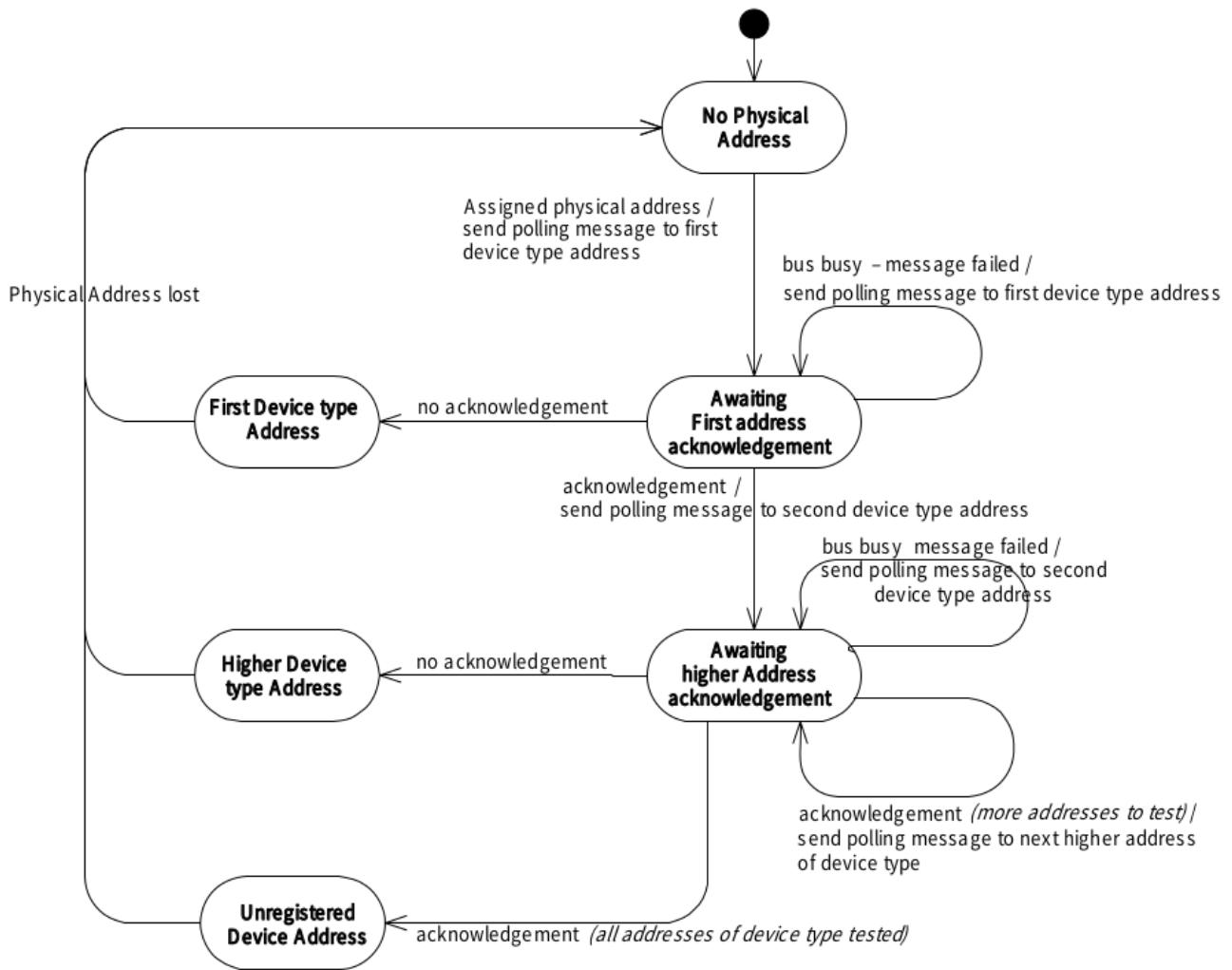


Figure 1-2 Logical address binding process

CEC devices communicate with each other by sending and receiving CEC MSG.

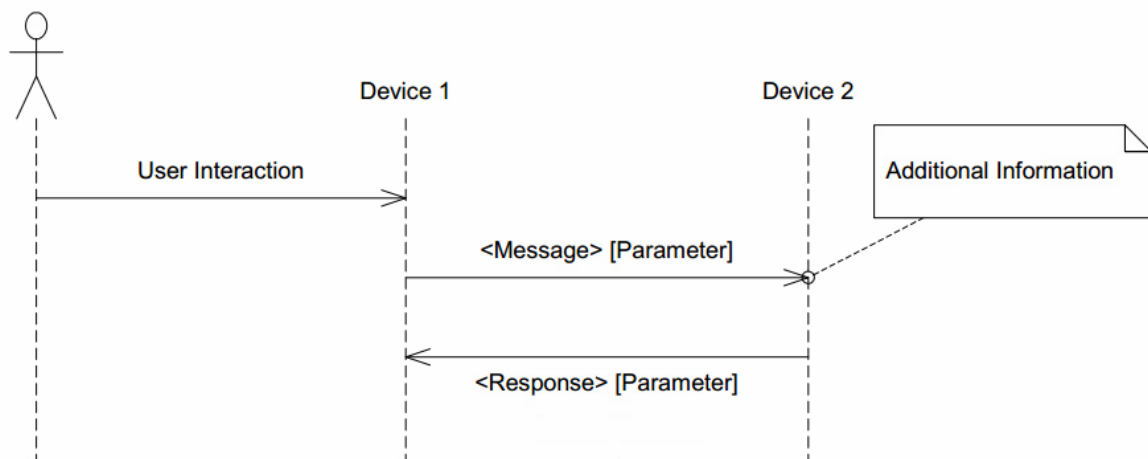


Figure 1-3 CEC Communication process

CEC MSG consists of a single or multiple blocks. The format of the block is as follows. It consists of 8 bits Header/Data and 1 bit EOM and 1 bit ACK. EOM indicates whether there is still data behind. When it is 1, it means that there is no data after the end of this CEC MSG. The ACK is a response bit and is set to 1 by sender. When receiver successfully receives the MSG, it will set it to 0, indicating that the data has been received.



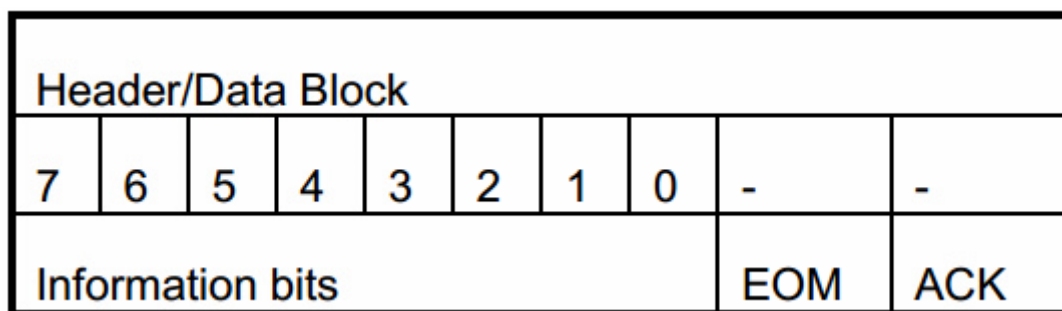


Figure 1-4 CEC MSG Block format

Header Block is the first block of CEC MSG. The upper 4 bits of the Information bits are the logical address of sender, and the lower 4 bits are the logical address of receiver. The Information bits of the Data Block are opcode or other parameters.

## 2 Enable CEC

### 2.1 Overview

Enabling of CEC functions requires hardware, kernel, and application support.

### 2.2 Hardware

As shown in Figure 2-1, CEC requires PORT\_CEC (13 Pin) in HDMI to be pulled up to 3.3V in hardware.

At the same time, since CEC is an optional function of HDMI, it is not necessarily connected to HDMI\_CEC pin on chip. In the figure below, the resistor R1036 is Not Connect. If CEC function is enabled, the resistor should be connected.

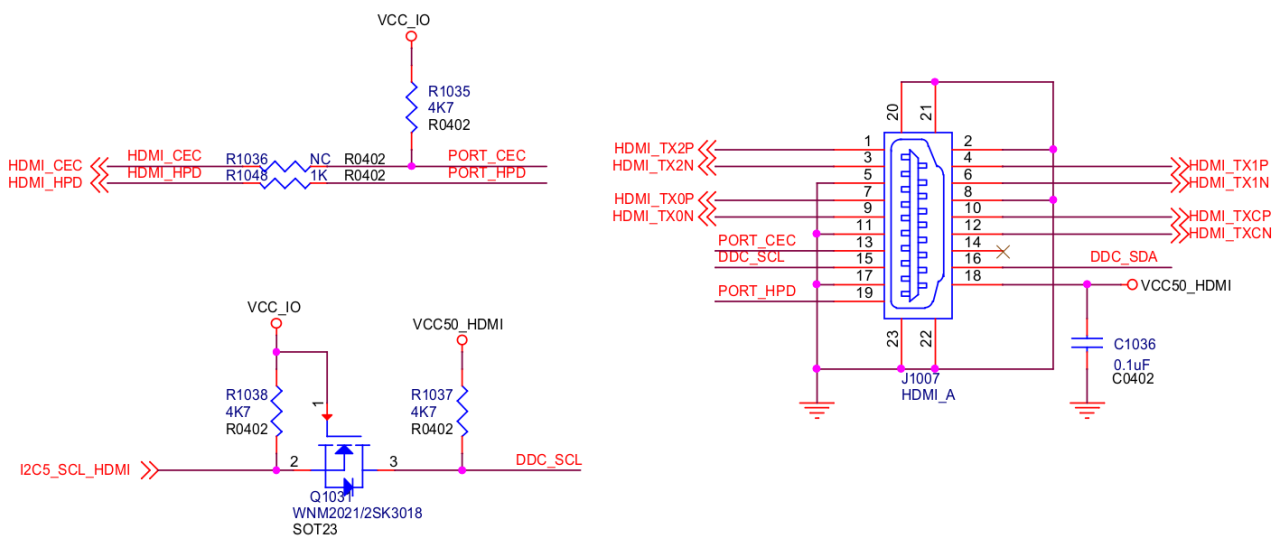


Figure 2-1 CEC Hardware schematic

### 2.3 Kernel

#### 2.3.1 CEC driver config

Users start compiling of CEC related driver by enabling the following options in kernel config:

```
CONFIG_DRM_DW_HDMI_CEC=y
CONFIG_MEDIA_CEC_SUPPORT=y
```

- CEC framework code:

drivers/media/cec/cec-adap.c	//The core part of the code is to achieve the binding of physical address and logical address and management of sending and receiving CEC events and messages, etc.
drivers/media/cec/cec-api.c	//Provide ioctl for calling user space.
drivers/media/cec/cec-core.c	//Registration of CEC device, etc.
drivers/media/cec/cec-notifier.c	//Notify CEC driver that logical address changes, etc.

- CEC driver code:

drivers/gpu/drm/bridge/synopsys/dw-hdmi-cec.c	//dw-hdmi-cec driver, is mainly used for operation of dw-hdmi CEC register.
---	---

### 2.3.2 CEC pinctl and clock

As a part of HDMI, CEC has a separate CLK for its operation inside the chip. This is configured in SDK by default and does not require special configuration.

The HDMI\_CEC pin is reused. When users need to enable CEC function, pinctrl-0 should be configured.

- In RK3288, HDMI\_CEC can be selected by one of the GPIOs:

```
ISP_FLASHTRIGIN/EDPHDMI_CEC_T1/GPIO7_C0_u
```

```
UART2_TX/IR_TX/PWM3/EDPHDMI_CEC/GPIO7_C7_u
```

- In RK3399, HDMI\_CEC should only be provided by the GPIO:

```
GPIO4_C7/HDMI_CECINOUT/EDP_HOTPLUG_u
```

Reference of CEC pinctl configuration:

```
hdmi: hdmi@ff980000 {
compatible = "rockchip,rk3288-dw-hdmi";
clocks = <&cru PCLK_HDMI_CTRL>, <&cru SCLK_HDMI_HDCP>,
<&cru SCLK_HDMI_CEC>;
clock-names = "iahb", "isfr", "cec";
pinctrl-names = "default", "sleep";
pinctrl-0 = <&hdmi_ddc>, <&hdmi_cec>;
pinctrl-1 = <&hdmi_gpio>;
...
};

pinctrl: pinctrl {
hdmi {
        hdmi_cec: hdmi-cec {
                rockchip,pins = <7 16 RK_FUNC_2 &pcfg_pull_none>;
        };
};
};
```

The HDMI\_CEC pin is reused with EDP\_HPD on RK3399, so if system enables both CEC and edp display, you need to set the force-hpd attribute on the edp node to disable EDP\_HPD function.

```
&edp {
force-hpd;
};
```

## 2.4 Application

The cec-ctl tool is provided by v4l-utils in Linux to control CEC devices through command line.

### 2.4.1 v4l-utils installation

- v4l-utils was installed by the following command in Debian system:

```
sudo apt-get install v4l-utils
```

- v4l-utils was installed by configuring the following build options in Buildroot system.

```
BR2_PACKAGE_LIBV4L=y
```

```
BR2_PACKAGE_LIBV4L_UTILS=y
```

## 2.4.2 Related commands

- Playback command:

```
[root@rk3288:/]# cec-ctl --playback -o Rockchip -V 0xaabbcc -M -T
```

Part of output log

```
CEC_ADAP_G_CAPS returned 0 (Success)
CEC_ADAP_G_PHYS_ADDR returned 0 (Success)
CEC_ADAP_S_LOG_ADDRS returned 0 (Success)
CEC_ADAP_S_LOG_ADDRS returned 0 (Success)
CEC_ADAP_G_LOG_ADDRS returned 0 (Success)
Driver Info:
Driver Name : dwhdmi-rockchip
Adapter Name : dw_hdmi
Capabilities : 0x0000000e
Logical Addresses
Transmit
Passthrough
Driver version : 4.4.167
Available Logical Addresses: 4
Physical Address : 1.0.0.0
Logical Address Mask : 0x0010
CEC Version : 2.0
Vendor ID : 0xaabbcc
Logical Address : 4 (Playback Device 1)
Primary Device Type : Playback
Logical Address Type : Playback
All Device Types : Playback
RC TV Profile : None
Device Features : None
Monitor All mode is not supported, falling back to regular monitoring
CEC_S_MODE returned 0 (Success)
CEC_DQEVENT returned 0 (Success)
```

CEC initialization will do basic information interaction, such as vendor id, osd name, CEC version.

```
Received from TV to Playback Device 1 (0 to 4): CEC_MSG_GIVE_DEVICE_VENDOR_ID (0x8c)
CEC_RECEIVE returned 0 (Success)
Transmitted by Playback Device 1 to all (4 to 15): CEC_MSG_DEVICE_VENDOR_ID (0x87):
vendor-id: 11189196 (0x00aabbcc)
CEC_RECEIVE returned 0 (Success)
```

```
Received from TV to Playback Device 1 (0 to 4): CEC_MSG_GIVE_OSD_NAME (0x46)
CEC_RECEIVE returned 0 (Success)
Transmitted by Playback Device 1 to TV (4 to 0): CEC_MSG_SET_OSD_NAME (0x47):
```

```
name: Rockchip
```

```
CEC_RECEIVE returned 0 (Success)
```

When a TV is on standby, the TV will send standby information to the chip.

```
Received from TV to all (0 to 15): CEC_MSG_STANDBY (0x36)
```

```
CEC_RECEIVE returned 0 (Success)
```

When the TV switches display source, the TV will send relevant information to the chip.

```
Received from TV to all (0 to 15): CEC_MSG_SET_STREAM_PATH (0x86):
```

```
phys-addr: 2.0.0.0
```

```
CEC_RECEIVE returned 0 (Success)
```

```
Received from TV to all (0 to 15): CEC_MSG_ROUTING_CHANGE (0x80):
```

```
orig-phys-addr: 0.0.0.0
```

```
new-phys-addr: 2.0.0.0
```

```
CEC_RECEIVE returned 0 (Success)
```

- One-touch-play command:

```
[root@rk3288:/]# cec-ctl --help-one-touch-play
```

One Touch Play Feature:

```
--active-source=phys-addr=<val> Send ACTIVE_SOURCE message (0x82)
```

```
--image-view-on Send IMAGE_VIEW_ON message (0x04)
```

```
--text-view-on Send TEXT_VIEW_ON message (0x0d)
```

Wake-up TV:

```
[root@rk3288:/]# cec-ctl --image-view-on -to 0
```

- Standby command:

```
[root@rk3288:/]# cec-ctl --standby --to 0
```

The usage of more commands of CEC user layer can be obtained by `cec-ctl --help`

## Note:

- At present, standby and wake-up of a chip cannot be operated by TV side. Standby can refer to chapter 2.4.2 Playback command, after receiving CEC\_MSG\_STANDBY, and calling `echo mem > /sys/power/state` by system can standby on the chip side synchronously. Currently wake-up is not well supported due to the operations related to trust and cec-clk, hdmi phy, etc. when in standby.
- Not all HDMI devices support CEC function. Please confirm whether TV or HDMI display device supports CEC and whether it supports specific CEC commands.