

## 1 简介

本文档描述了如何根据教程示例来构建实现 USB 总线和 CAN 总线之间的通信桥接。USB 选取 USB CDC 设备来传输数据。

该文档有助于：

1. 想熟悉并开始使用 USB CDC 应用程序；
2. 想了解 SDK CAN 驱动程序；
3. 想为他们的应用快速建立一个 USB\_CAN 桥接。

### 1.1 术语

表 1. 术语表

项目	描述
CAN	控制器局域网
CDC	USB 通信设备类

## 2 实施

### 2.1 概述

本应用文档的目的是建立一个 USB\_CAN 桥接，在这里 USB 数据重新传输到 CAN 总线，反之亦然。LPC54608 有两个 USB 控制器和两个 CAN 控制器。我们只使用一个 USB 控制器和一个 CAN 控制器。

表 2. 使用的 MCU 外设资源

使用的 IP	描述
USB1	使用 USB1 作为全速 USB 设备
CAN0	CAN0 接口

系统框图如 [图 1](#) 所示。SDK 已经提供了 CAN 驱动程序和 USB 堆栈。您需要为每个通道添加两个缓冲区，一个用于 USB->CAN 总线，另一个用于 CAN ->USB 总线。两个通道相互独立以确保最佳的性能。

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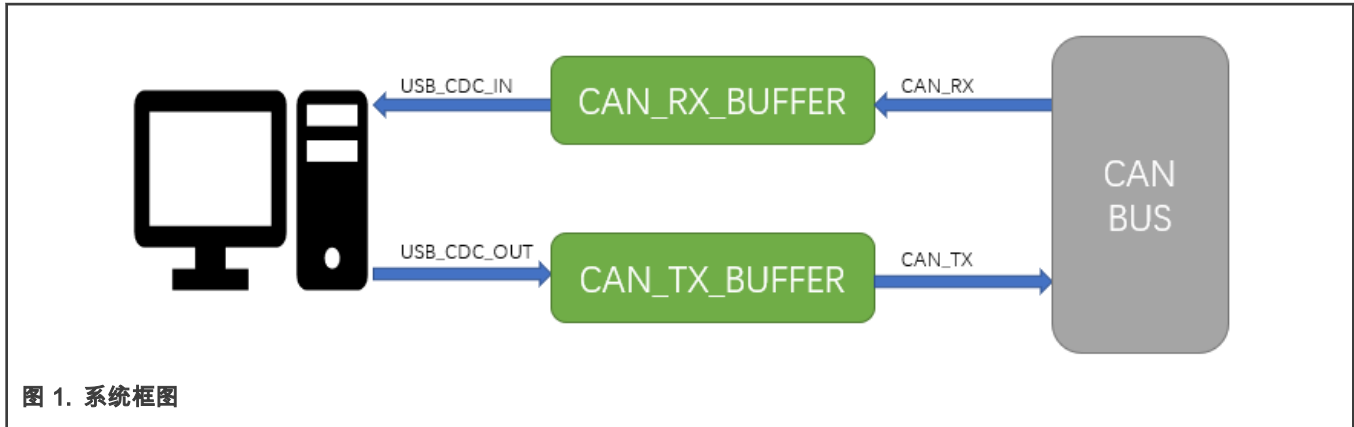


图 1. 系统框图

## 2.2 相关 SDK 示例

该软件基于两个 SDK 示例：

### 2.2.1 MCAN 环回示例

MCAN 是一个简单的 CAN 环回示例，演示了 LPC54608 的 CAN 模块的用法。此示例启用 CAN 模块的内部环回并发送 CAN 帧，CAN 帧环回到 CAN 接收器，MCU 在 UART 终端上显示任何接收到的 CAN 帧。我们建议用户阅读示例介绍文档，并运行示例程序以熟悉这个示例。

示例程序位置：

```
\SDK_2.6.0_LPC54608J512\boards\lpcxpresso54608\driver_examples\mcan\loopback
```

### 2.2.2 usb\_device\_cdc\_vcom 示例

USB CDC 类示例将 USB 作为通信设备。设置完成后，设备上会弹出一个 COM 端口，任何字符都会通过这个 COM 端口环回显示。有关如何安装设备驱动程序和运行示例，请参阅本示例介绍文档。

示例位置：

```
SDK_2.6.0_LPC54608J512\boards\lpcxpresso54608\usb_examples\usb_device_cdc_vcom\bm
```

## 2.3 将这两个例子结合成 USB CAN 桥接应用

以上两个 SDK 示例提供了实现构建 USB-CAN 桥接的模块。软件需要执行以下任务：

1. 将 CAN 驱动程序集成到 usb\_device\_cdc\_vcom 示例中，并将 CAN0 模块启用和配置为环回模式。
2. USB 和 CAN 以不同的速度运行，我们需要配置两个 FIFO，一个用于 CAN Tx 缓冲区，一个用于 CAN Rx 缓冲区，如图 1 所示。
3. 连接这些通信接口，当 USB 输出数据包到达时，将数据缓冲到 CAN 发送缓冲区。当 CAN 总线接收到一个数据帧时，将数据缓冲到 CANU RX 缓冲区。
4. 创建两个单独的线程，一个用于 CAN 发送：当 CAN 发送缓冲区不为空时，获取缓冲区数据并发送到 CAN 总线。另一个线程服务于 USB 接口：当 CAN 接口缓冲区不为空时，获取缓冲区数据并通过 USB CDC 发送到 PC。

主要配置方式如下：

1. 在 CAN0 中断处理程序中，当接收到 CAN 数据帧时，将数据存放到 CANU RXIU 缓冲区：

```
void CAN0_IRQ0_IRQHandler(void)
{
    static mcan_rx_buffer_frame_t rxFrame;
```

```

MCAN_ClearStatusFlag(CAN0, CAN_IR_RF0N_MASK);
MCAN_ReadRxFifo(CAN0, 0, &rxFrame);
msg_t msg;
msg.cmd = MSG_CAN_RX;
msg.len = rxFrame.dlc;
memcpy(msg.buf, rxFrame.data, msg.len);
/* push data into CAN_RX_BUFFER */
mq_push(msg);
}

```

- 在 APPTask 函数中，轮询消息缓冲区，查看是否有消息进入，如果接收到 CAN\_TX 消息，则调用 SDK 驱动程序 CAN\_TX 函数向 CAN 总线发送数据。如果接收到 CAN\_RX 消息，调用 USB Stack API: USB\_DeviceCdcAcmSend 将数据发送到 PC。

```

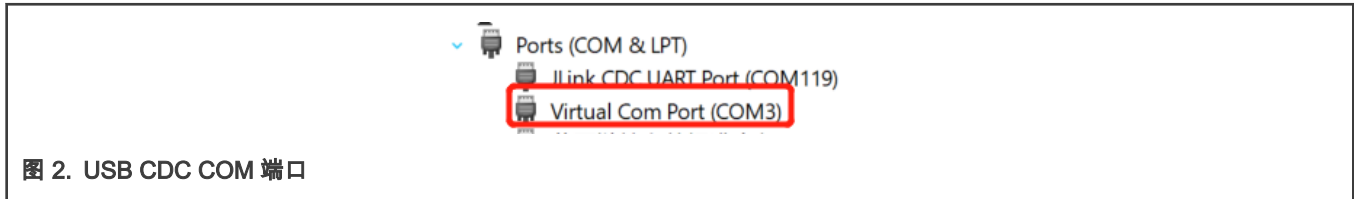
void APPTask(void)
{
msg_t can_tx_msg;
msg_t *pMsg;
uint8_t usb_tx_flag = 0;
if ((1 == s_cdcVcom.attach) && (1 == s_cdcVcom.startTransactions))
{
if ((0 != s_recvSize) && (0xFFFFFFFFU != s_recvSize))
{
/* push data to CAN_TX_BUFFER */
can_tx_msg.cmd = 0;
can_tx_msg.len = s_recvSize;
memcpy(can_tx_msg.buf, s_currRecvBuf, can_tx_msg.len);
mq_push(can_tx_msg);
s_recvSize = 0;
}
/* handle messages */
if(mq_exist())
{
pMsg = mq_pop();
switch(pMsg->cmd)
{
case MSG_USB_RX:
app_can_send(CAN_TX_ID, pMsg->buf, pMsg->len)
break;
case MSG_CAN_RX:
//dump_data(pMsg->buf, pMsg->len);
memcpy(s_currSendBuf, pMsg->buf, pMsg->len);
USB_DeviceCdcAcmSend(s_cdcVcom.cdcAcmHandle, USB_CDC_VCOM_BULK_IN_ENDPOINT,
s_currSendBuf, pMsg->len);
usb_tx_flag = 1;
break;
}
}
/* send a empty USB_IN packet */
if(usb_tx_flag == 0)
{
USB_DeviceCdcAcmSend(s_cdcVcom.cdcAcmHandle, USB_CDC_VCOM_BULK_IN_ENDPOINT,
s_currSendBuf, 0);
}
usb_tx_flag = 0;
}
}

```

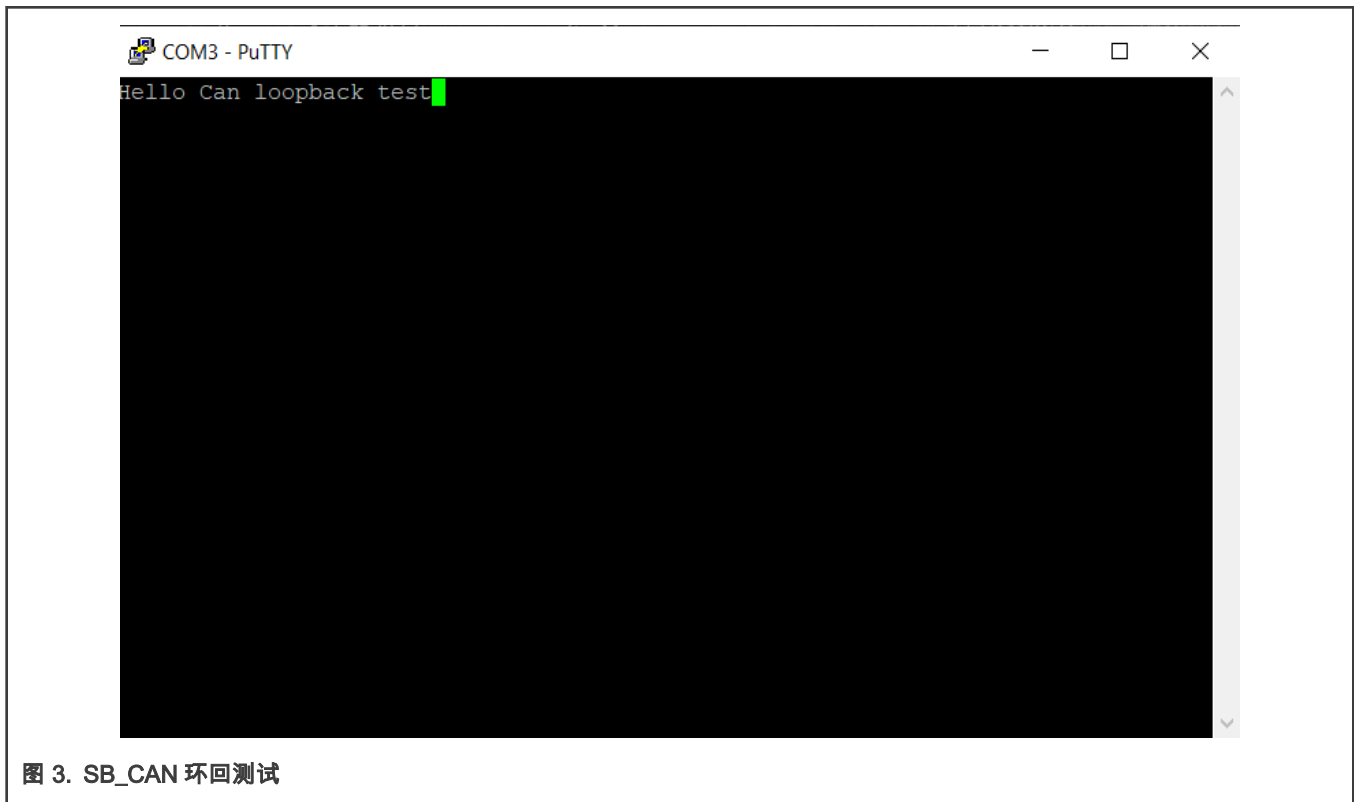
### 3 测试

由于启用了 CAN 环回模式，并且 CAN Tx 帧 ID 与 CAN Rx FIFO 相同，因此任何由 CAN0 发送的数据可以环回发送回自身。因此，任何数据从 PC 发送的数据可以环回发送回 PC。我们使用这一点来检查代码的功能。

将 USB 电缆插入 J3 USB 全速端口，界面弹出显示 USB CDC 设备，如 图 2 所示：



使用 Putty 在 open COM 端口上输入小于等于 8 字节的字符，数据环回显示在终端。如 图 3 所示：



### 4 结论与局限

本文介绍了一种基于 MCUxpresso SDK 构建 CAN\_USB 桥接的简单方法，并给出了使用异步通信软件通道的一个通用软件架构。

本示例中的限制包括：

1. 在此示例中，CAN Tx 帧和 CAN Rx 帧都使用 ID 为 0x123 的标准数据帧。
2. 根据 CAN2.0 规范，一个 CAN 数据帧最多只能承载 8 字节的数据。因此，USB CDC 一次最多只能发送 8 个字节。如果数据长度大于 8 字节，则丢弃超出的数据。

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