SC16IS752 I2C to UART For IW416 Bluetooth Application

- **Software Configurations**

1. **Linux Kernel Version**

   L6.6.3_1.0.0 bsp for i.MX8MP-EVK

2. **WiFi driver version**

   - Generic_ SD-WLAN-UART-BT-IW416-LNX_6_6_36-IMX8-16.92.21.p137.4-16.92.21.p137.4-MM6X16437.P31-GPL

   Or

   - WiFi driver supported by L6.6.3_1.0.0 bsp

   These 2 driver are the same version

3. **Software Configurations**

① **Kernel Options**

```
CONFIG_SERIAL_DEV_BUS=m
CONFIG_SERIAL_SC16IS7XX_CORE=y
CONFIG_SERIAL_SC16IS7XX=y
CONFIG_SERIAL_SC16IS7XX_I2C=y
```

◆ **Operations in Yocto bsp**

   If images have been built before, run the command

source setup-environment build-wayland-8mp/

   If not, run the comamnd

DISTRO=fsl-imx-wayland MACHINE=imx8mp-lpddr4-evk source imx-setup-release.sh -b build-wayland-8mp

   [Note]

   build-wayland-8mp is compilation directory.
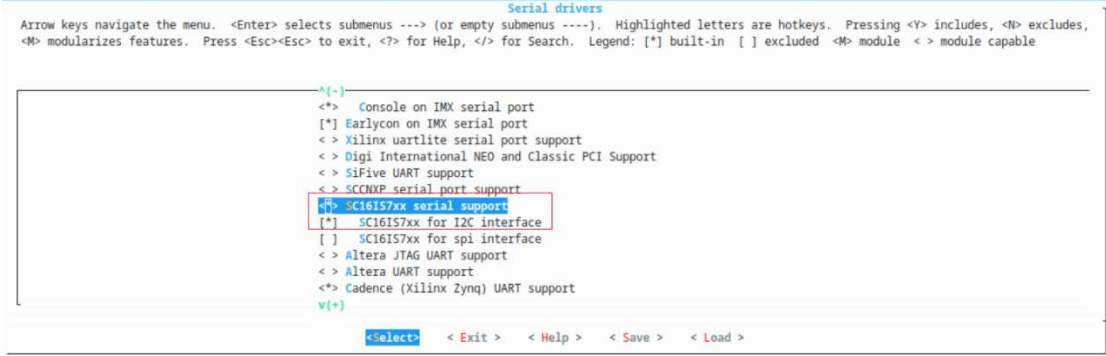
bitbake linux-imx -c menuconfig

❶ **Settings for SC16IS752**

   Device drivers

   --->Character devices

   --->Serial drivers

❷ **Serial device bus**

   Device drivers

   --->Character devices

   ---> Serial device bus

Character devices

Arrow keys navigate the menu. <Enter> selects submenus ---> (or empty submenus ----). Highlighted letters are hotkeys. Pressing <Y> includes, <N> excludes,
<M> modularizes features. Press <Esc><Esc> to exit, <?> for Help, </> for Search. Legend: [*] built-in [ ] excluded <M> module < > module capable

```
                            ^(-)
         < >   HSDPA Broadband Wireless Data Card - Globe Trotter
         < >   NULL TTY driver
         [*]   Xen Hypervisor Console support
         [*]      Xen Hypervisor Multiple Consoles support
         [ ]   ARM JTAG DCC console
         <M>   RPMSG tty driver
         <M> Serial device bus   ----
         <*> Virtio console
         <M> IPMI top-level message handler  ----
         [ ] Generate a panic event to all BMCs on a panic
         <M> Device interface for IPMI
         <M> IPMI System Interface handler
         v(+)

              <Select>    < Exit >    < Help >    < Save >    < Load >
```

Save & Exit.

② ./conf/local.conf

Add character conversion library.

vim ./conf/local.conf

……

IMAGE_INSTALL:append = " glibc-gconv-utf-16 glibc-utils"

……

Save & Exit.

The library will be used when performing file transmission over Bluetooth using Obex protocol.

③ SC16IS752 node in linux device tree(imx8mp-evk.dts)

```
&i2c3 {
        clock-frequency = <400000>;
        pinctrl-names = "default";
        pinctrl-0 = <&pinctrl_i2c3>;
        status = "okay";

……    /* other devices on I2C3 */

        sc16is752: sc16is752@49 {
                compatible = "nxp,sc16is752";
                clocks = <&sc16is752_clk>;
                gpio-controller;
                status = "okay";
                interrupt-parent = <&gpio3>;
                interrupts = <19 2>; /* 2, means IRQ_TYPE_EDGE_FALLING*/
                reg = <0x49>;
                i2c-max-frequency = <400000>;
                #gpio-cells = <0x2>;
                pinctrl-assert-gpios = <&pca6416 7 GPIO_ACTIVE_HIGH>; /* pull up reset pin to HIGH*/
                clock-frequency = <18432000>; /* the clock-frequency can be: 1843200 / 3072000 / 1228800 */

                sc16is752_clk: sc16is752_clk { /* the sub-node is used to describe external crystal on hardware */
                        compatible = "fixed-clock";
                        #clock-cells = <0x0>;
                        clock-frequency = <14745600>;
                };
        };
}

[Note]
     --If target baud rate is 2400/4800/9600/19200/38400bps, clock-frequency=<3072000> is the better choice
     -- If target baud rate is 57600/115200bps, clock-frequency=<18432000> is the better choice
                That is to say, make the clock frequency an integer multiple of the baud rate.
```

④ GPIO3_19 & GPIO3_20 IOMUX in device tree (imx8mp-evk.dts)

```
&iomuxc {
        pinctrl-names = "default";
        pinctrl-0 = <&pinctrl_hog>;

        pinctrl_hog: hoggrp {
                fsl,pins = <

······ /* Other GPIOs IOMUX */

                        MX8MP_IOMUXC_SAI5_RXFS__GPIO3_IO19        0x150
                >;
        };

[Note]
        Default device tree uses GPIO3_19 to be PWM4, so pwm4 node should be commented like below:

/*
        pinctrl_pwm4: pwm4grp {
                fsl,pins = <
                        MX8MP_IOMUXC_SAI5_RXFS__PWM4_OUT    0x116
                >;
        };
*/
······
/*
&pwm4 {
        pinctrl-names = "default";
        pinctrl-0 = <&pinctrl_pwm4>;
        status = "okay";
};
*/
```

4. Building Yoto images

bitbake imx-image-multimedia

After compilation is done, all images can be seen in the directory:
~/imx-yocto-bps/L6.6.3_1.0.0/build-wayland-8mp/tmp/deploy/images/imx8mp-lpddr4-evk

5. Burning images to eMMC on i.MX8MP-EVK

① Image files

We probably need these image files

Name	Date modified	Type	Size
example_kernel_emmc.uuu	2024/9/18 17:45	UUU File	4 KB
fsl-image-mfgtool-initramfs-imx_mfgtools.cpio.zst.u-boot	2024/3/5 18:58	U-BOOT File	12,661 KB
Image--6.6.3+git0+ccf0a99701-r0-imx8mp-lpddr4-evk-20241017101330.bin	2024/10/17 22:50	BIN File	33,997 KB
imx8mp-evk.dtb	2024/10/17 22:50	DTB File	83 KB
imx-boot-imx8mp-lpddr4-evk-sd.bin-flash_evk	2024/10/17 22:50	BIN-FLASH_EVK File	2,128 KB
imx-image-multimedia-imx8mp-lpddr4-evk.rootfs-20241017101330.tar.zst	2024/10/17 22:47	ZST File	839,494 KB
imx-image-multimedia-imx8mp-lpddr4-evk.rootfs-20241017101330.wic	2024/10/17 21:36	WIC File	5,902,183 KB
imx-image-multimedia-imx8mp-lpddr4-evk.rootfs-20241017101330.wic.zst	2024/10/17 21:36	ZST File	848,541 KB
uuu.auto-imx8mpevk	2024/9/23 16:45	AUTO-IMX8MPEVK File	2 KB
uuu	2022/10/23 19:43	Application	1,438 KB

[Note]

- **These files can be copied from DEMO Images**
  Users can log in nxp website and download demo images, after decompressing it, these files can be found.
❶ example_kernel_emmc.uuu

❷   fsl-image-mfgtool-initramfs-imx_mfgtools.cpio.zst.u-boot

❸   uuu.auto-imx8mpevk

- **uuu tool**
    - ➢ **uuu usage**

        https://github.com/nxp-imx/mfgtools
    - ➢ **uuu release**

        https://github.com/nxp-imx/mfgtools/releases

        Users can download stable version of uuu

❹ **Full image file**

imx-image-multimedia-imx8mp-lpddr4-evk.rootfs-20241017101330.wic.zst can't be used directly, it should be decompressed using like 7z, and get .wic file.

imx-image-multimedia-imx8mp-lpddr4-evk.rootfs-20241017101330.wic

❺ **Changing images' name in uuu.auto-imx8mpevk**

```
uuu_version 1.2.39

# This command will be run when i.MX6/7 i.MX8MM, i.MX8MQ
SDP: boot -f imx-boot-imx8mp-lpddr4-evk-sd.bin-flash_evk

# This command will be run when ROM support stream mode
# i.MX8QXP, i.MX8QM
SDPS: boot -f imx-boot-imx8mp-lpddr4-evk-sd.bin-flash_evk

# These commands will be run when use SPL and will be skipped if no spl
# SDPU will be deprecated. please use SDPV instead of SDPU
# {
SDPU: delay 1000
SDPU: write -f imx-boot-imx8mp-lpddr4-evk-sd.bin-flash_evk -offset 0x57c00
SDPU: jump
# }

# These commands will be run when use SPL and will be skipped if no spl
# if (SPL support SDPV)
# {
SDPV: delay 1000
SDPV: write -f imx-boot-imx8mp-lpddr4-evk-sd.bin-flash_evk -skipspl
SDPV: jump
# }

FB: ucmd setenv fastboot_dev mmc
FB: ucmd setenv mmcdev ${emmc_dev}
FB: ucmd mmc dev ${emmc_dev}
FB: flash -raw2sparse all imx-image-multimedia-imx8mp-lpddr4-evk.rootfs-20241017101330.wic
FB: flash bootloader imx-boot-imx8mp-lpddr4-evk-sd.bin-flash_evk
FB: ucmd if env exists emmc_ack; then ; else setenv emmc_ack 0; fi;
FB: ucmd mmc partconf ${emmc_dev} ${emmc_ack} 1 0
FB: done
```

② **Starting burning images**
- Run windows shell using cmd and enter image's path
- Setting i.mx8mp-evk to Serial Downloader mode on SW4

- Connecting USB-TYPE-C of i.MX8MP-EVK to PC USB
- Run "uuu uuu.auto-imx8mpevk"

```
Microsoft Windows [Version 10.0.19045.4894]
(c) Microsoft Corporation. All rights reserved.

C:\Users\nxa22310>e:

E:\>cd E:\imx8mp\imx8mp-yocto-build-for-sc16is752-iw416

E:\imx8mp\imx8mp-yocto-build-for-sc16is752-iw416>uuu uuu.auto-imx8mpevk
uuu (Universal Update Utility) for nxp imx chips -- libuuu_1.4.243-0-ged48c51

Success 0    Failure 0


1:4       4/ 8 [===>             11%               ] FB: flash -raw2sparse all imx-image-multimedia-imx8mp-lpddr4-evk.
```

Windows Command Line

```
U-Boot SPL 2023.04+gf8a2983ec83+p0 (Mar 04 2024 - 07:25:04 +0000)
DDRINFO: start DRAM init
DDRINFO: DRAM rate 4000MTS
DDRINFO:ddrphy calibration done
DDRINFO: ddrmix config done
SEC0:  RNG instantiated
Normal Boot
Trying to boot from BOOTROM
Boot Stage: USB boot
Find img info 0x4801f1a0, size 1064
Need continue download 1024
Download 1816384, Total size 1818016
NOTICE:  Do not release JR0 to NS as it can be used by HAB
NOTICE:  BL31: v2.8(release):lf-6.6.3-1.0.0-0-g8dbe28631
NOTICE:  BL31: Built : 17:57:56, Jan 22 2024


U-Boot 2023.04+gf8a2983ec83+p0 (Mar 04 2024 - 07:25:04 +0000)

CPU:   i.MX8MP[8] rev1.1 1800 MHz (running at 1200 MHz)
CPU:   Commercial temperature grade (0C to 95C) at 28C
Reset cause: POR
Model: NXP i.MX8MPlus LPDDR4 EVK board
DRAM:  6 GiB
TCPC:  Vendor ID [0x1fc9], Product ID [0x5110], Addr [I2C2 0x50]
SNK.Power3.0 on CC1
PDO 0: type 0, 5000 mV, 3000 mA [E]
PDO 1: type 0, 9000 mV, 3000 mA []
PDO 2: type 0, 15000 mV, 3000 mA []
PDO 3: type 0, 20000 mV, 2250 mA []
Requesting PDO 3: 20000 mV, 2250 mA
```

Logs on console

```
Microsoft Windows [Version 10.0.19045.4894]
(c) Microsoft Corporation. All rights reserved.

C:\Users\nxa22310>e:

E:\>cd E:\imx8mp\imx8mp-yocto-build-for-sc16is752-iw416

E:\imx8mp\imx8mp-yocto-build-for-sc16is752-iw416>uuu uuu.auto-imx8mpevk
uuu (Universal Update Utility) for nxp imx chips -- libuuu_1.4.243-0-ged48c51

Success 1    Failure 0


1:4       8/ 8 [Done                               ] FB: done


E:\imx8mp\imx8mp-yocto-build-for-sc16is752-iw416>
```

Done

③ **Booting board**
- Power off i.MX8MP-EVK Board
- Set "boot from eMMC" on SW4
- Power On IW416-EVK with 5V input

- Power On i.MX8MP-EVK Board
- Input **root** to log in linux
- Checking device node in /dev/

```
root@imx8mp-lpddr4-evk:~# ls /dev/ttyS*
/dev/ttyS0   /dev/ttyS1   /dev/ttyS2   /dev/ttyS3   /dev/ttySC0   /dev/ttySC1
root@imx8mp-lpddr4-evk:~#
```

[Note]
- /dev/ttySC0 is the device node of SC16IS752 UART channel A
- /dev/ttySC1 is the device nod of SC16IS752 UART channel B
- Using zcat to check kernel configurations

```
root@imx8mp-lpddr4-evk:~# zcat /proc/config.gz | grep 'DEV_BUS'
CONFIG_SERIAL_DEV_BUS=m
root@imx8mp-lpddr4-evk:~# zcat /proc/config.gz | grep 'SC16IS'
CONFIG_SERIAL_SC16IS7XX_CORE=y
CONFIG_SERIAL_SC16IS7XX=y
CONFIG_SERIAL_SC16IS7XX_I2C=y
# CONFIG_SERIAL_SC16IS7XX_SPI is not set
root@imx8mp-lpddr4-evk:~#
```

- Loading serdev.ko driver

```
root@imx8mp-lpddr4-evk:~# modprobe serdev
root@imx8mp-lpddr4-evk:~# lsmod
Module                  Size   Used by
serdev                 24576   0
overlay               135168   0
fsl_jr_uio             12288   0
caam_jr               155648   0
……
can_dev                45056   1 flexcan
imx_dsp_rproc          16384   0
fuse                  131072   1
```

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