CONFIDENTIAL B

Touch Panel Driver Bringup SOP---for Andorid O

Outline

- Key words
- CTP HW interface and Platform instruction
  - I2C interface user guide
- Mediatek Touch Driver Introduction
  - driver architecture
  - useful APIs
  - coordinate calibration method
- touch customization
  - project Config
  - kernel config
  - device tree(dts) of dts
- add a new touch driver step by step
- touch debug

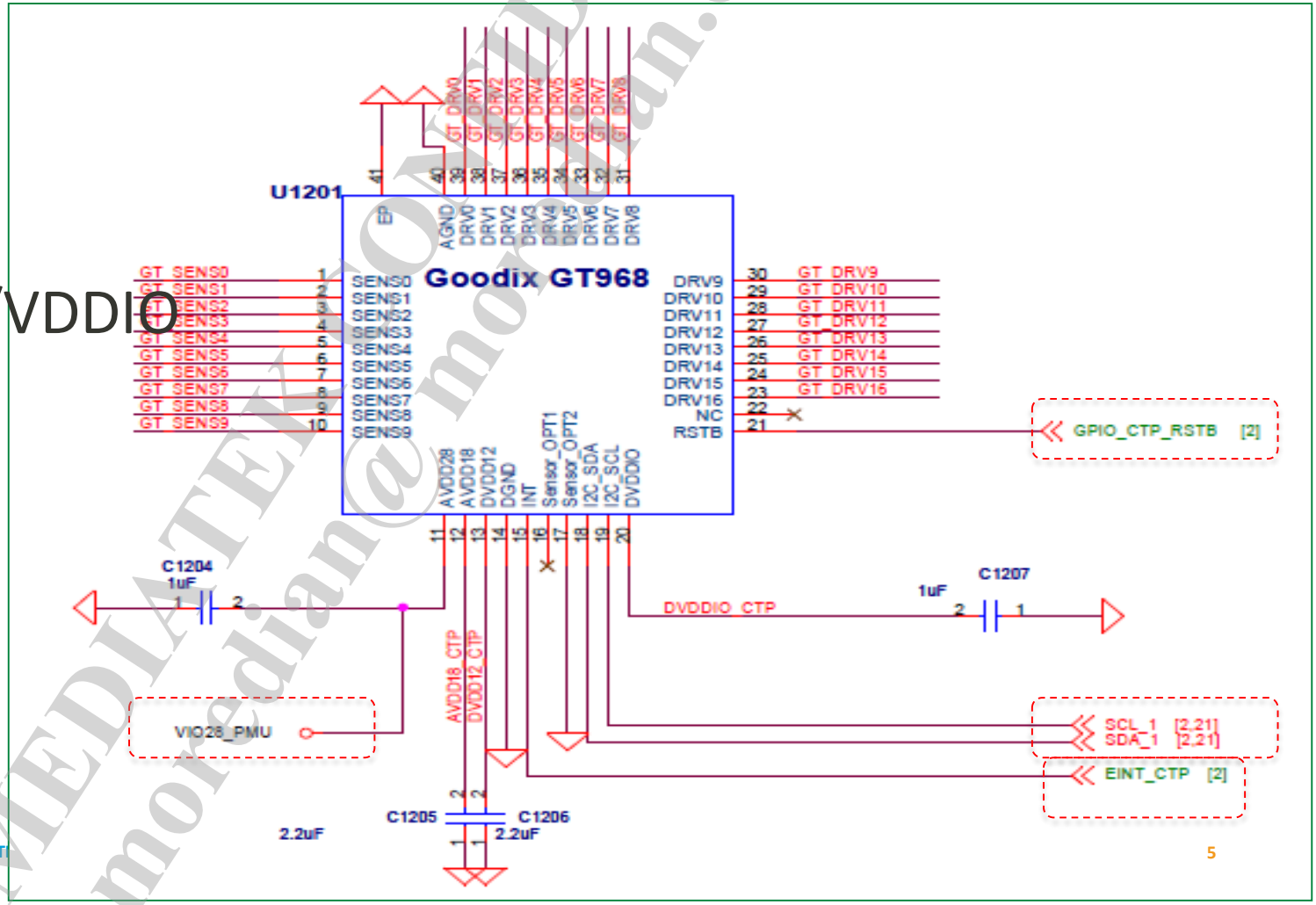
Key words

- <proj>
  - project name, e.g. tb8183m1_64
- <platform>
  - platform, e.g. mt8183
- <kernel_ver>
  - linux kernel version , e.g. kernel-4.4
- <arm_ver>:
  - arm or arm64
- <tp_drv>:
  - specific touch driver name， e.g. GT5688
- <cust_folder>:
  - customize information folder e.g. folder for touch config file: “config_default”

CTP HW and Platform Instruction

CTP HW interface

- e.g. GT968 HW pad：
  - I2C
  - EINT
  - RST
  - AVDD/VDDIO
  - GND



Platform instruction

- GPIO /EINT/POWER
  - After got the HW information, you should apply your hardware interface to device tree(".dts"), such as EINT/RST/Power … etc.
- I2C
  - Mediatek platform I2C support：
    - FIFO mode： read/write 8 Bytes one time
    - DMA mode： only read/write: 65532Byte;
      write and read: write 255 Byte, read 31Byte

NOTE: For DMA 255x255Byte: The low 8-bit is "trans_len".
The high 8-bit is "trans_num"

```
trans_len = (msg->len) & 0xFF;
trans_num = (msg->len >> 8) & 0xFF;
```

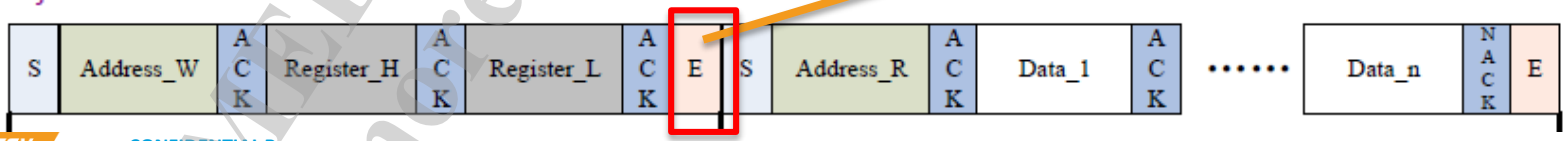
I2C interface-Read with FIFO mode

- read with FIFO mode, max 8 bytes one time
  - write and read mode: I2C_WR_FLAG
  - without stop condition after register address write: I2C_RS_FLAG

Multiple Read


```
static s32 i2c_read_nondma(struct i2c_client *client,
    u8 addr, u8 *rxbuf, int len)
{
    int ret;
    struct i2c_msg msg;

    memset(&msg, 0, sizeof(struct i2c_msg));
    rxbuf[0] = addr;
    msg.addr = client->addr & I2C_MASK_FLAG;
    msg.flags = 0;
    msg.len = ((len & 0x1f) << 8) | 1;
    msg.buf = rxbuf;
    msg.ext_flag = I2C_WR_FLAG | I2C_RS_FLAG;
    msg.timing = GSLTP_I2C_MASTER_CLOCK;
    ret = i2c_transfer(client->adapter, &msg, 1);
    return ret;
}
```

if stop condition need after register addr, please remove I2C_RS_FLAG



I2C interface—Write with FIFO mode

- write with FIFO mode
  - max write 8 bytes one time

```
static s32 i2c_write_nondma(struct i2c_client *client, u8 addr, u8 *txbuf, int len)
{
    int ret;
    int retry = 0;
    struct i2c_msg msg;
    u8 wrBuf[RPR_FIFO_MAX_WR_SIZE + 1];

    if ((txbuf == NULL) && len > 0)
        return -1;

    memset(&msg, 0, sizeof(struct i2c_msg));
    memset(wrBuf, 0, RPR_FIFO_MAX_WR_SIZE + 1);
    wrBuf[0] = addr;
    if (txbuf)
        memcpy(wrBuf + 1, txbuf, len);

    msg.flags = 0;
    msg.buf = wrBuf;
    msg.len = 1 + len;
    msg.addr = (client->addr & I2C_MASK_FLAG);
    msg.ext_flag = (client->ext_flag | I2C_ENEXT_FLAG);
    msg.timing = RPR_I2C_MASTER_CLOCK;

    for (retry = 0; retry < 5; ++retry) {
        ret = i2c_transfer(client->adapter, &msg, 1);
        if (ret < 0)
            continue;
        return 0;
    }
    RPR0521_ERR("Dma I2C Write Error: 0x%04X, %d bytes, err-code: %d\n", addr, len, ret).
    return ret;
} ? end i2c_write_nondma ?
```

```
#define RPR_FIFO_MAX_RD_SIZE C_I2C_FIFO_SIZE
#define RPR_FIFO_MAX_WR_SIZE C_I2C_FIFO_SIZE - RPR_REG_ADDR_LEN
```

Parameter of i2c_write_nond

I2C interface—read with DMA WRRD mode

- read with DMA mode: I2C_DMA_FLAG
  - with write and read mode: I2C_WR_FLAG, max 31bytes
  - without stop condition after register address write: I2C_RS_FLAG

```
static s32 i2c_dma_read(struct i2c_client *client, u8 addr, u8
{
    int ret;
    struct i2c_msg msg;

    memset(&msg, 0, sizeof(struct i2c_msg));
    *g_dma_buff_va = addr;
    msg.addr = client->addr & I2C_MASK_FLAG;
    msg.flags = 0;
    msg.len = ((len & 0x1f) << 8) | 1;
    msg.buf = g_dma_buff_pa;
    msg.ext_flag = I2C_WR_FLAG | I2C_RS_FLAG | I2C_DMA_FLAG;
    msg.timing = GSLTP_I2C_MASTER_CLOCK;

    ret = i2c_transfer(client->adapter, &msg, 1);
    memcpy(rxbuf, g_dma_buff_va, len);
    return ret;
}
```

I2C interface—read only with DMA mode

- read only with DMA mode: have I2C_DMA_FLAG but no I2C_WR_FLAG
- there will be a stop condition between msg[0] and msg[1]
- max read length is 65532 bytes

```
static s32 i2c_dma_non_wrrd_read(struct i2c_client *client, u
{
    int ret;
    struct i2c_msg msg[2];

    memset(&msg, 0, 2 * sizeof(struct i2c_msg));
    msg[0].addr = client->addr & I2C_MASK_FLAG;
    msg[0].flags = 0;
    msg[0].len = GSLTP_REG_ADDR_LEN;
    msg[0].buf = &addr;
    msg[0].ext_flag = I2C_DMA_FLAG;
    msg[0].timing = GSLTP_I2C_MASTER_CLOCK;

    msg[1].addr = client->addr & I2C_MASK_FLAG;
    msg[1].flags = 0;
    msg[1].len = len;
    msg[1].buf = g_dma_buff_pa;
    msg[1].ext_flag = I2C_DMA_FLAG;
    msg[1].timing = GSLTP_I2C_MASTER_CLOCK;

    ret = i2c_transfer(client->adapter, &msg, 2);
    memcpy(rxbuf, g_dma_buff_va, len);
    return ret;
} ? end i2c_dma_non_wrrd_read ?
```

I2C interface—Write with DMA mode

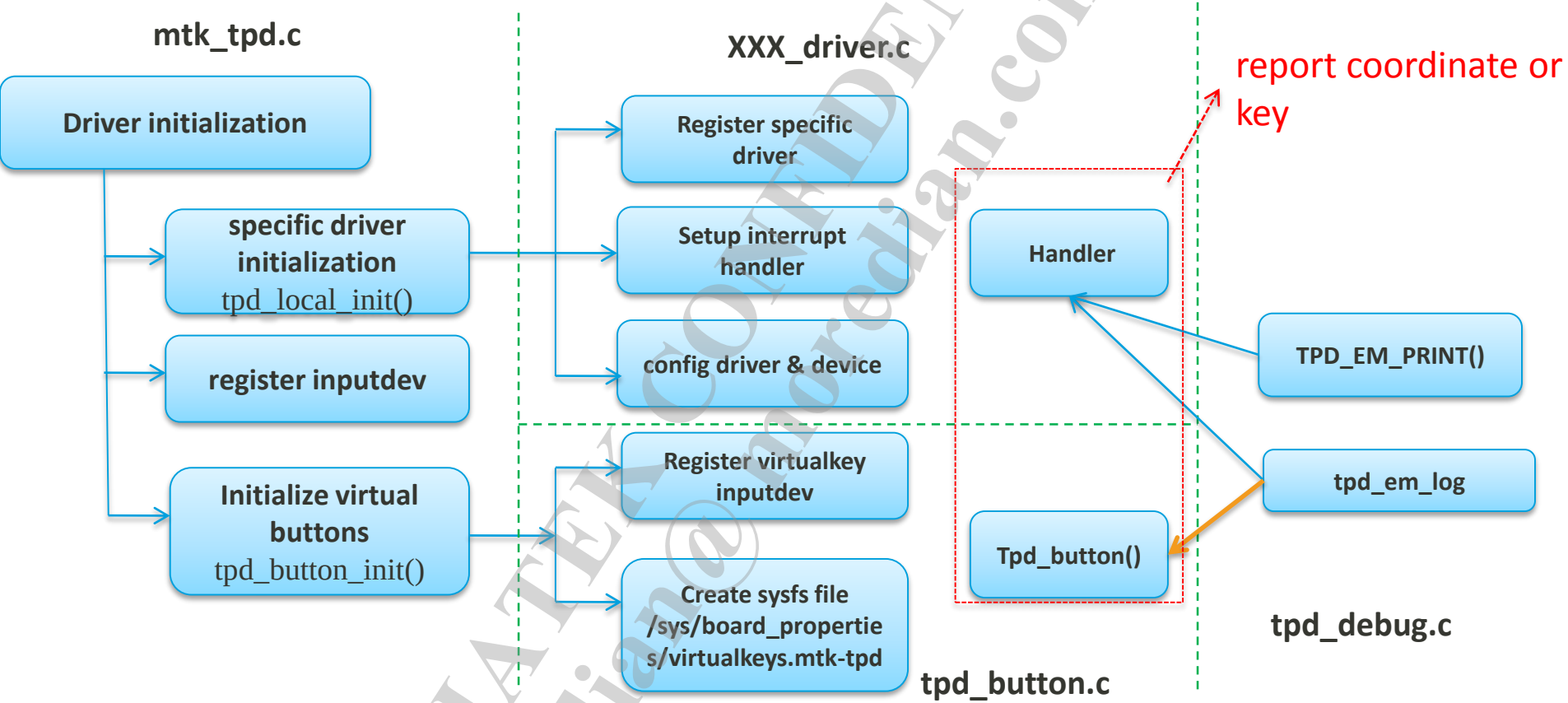
- write with DMA mode, max 65532 bytes

```
static s32 i2c_dma_write(struct i2c_client *client, u8 addr, u8
{
    int ret;
    struct i2c_msg msg;

    memset(&msg, 0, sizeof(struct i2c_msg));
    *g_dma_buff_va = addr;
    msg.addr = (client->addr & I2C_MASK_FLAG);
    msg.flags = 0;
    msg.buf = g_dma_buff_pa;
    msg.len = 1 + len;
    msg.ext_flag = (client->ext_flag | I2C_ENEXT_FLAG \
            | I2C_DMA_FLAG);
    msg.timing = GSLTP_I2C_MASTER_CLOCK;

    memcpy(g_dma_buff_va + 1, txbuf, len);
    ret = i2c_transfer(client->adapter, &msg, 1);
    return ret;
}
```

Mediatek touch driver introduction

driver architecture and useful notes

Touch Panel Driver Architecture



All specific touch driver are mounted on MTK common touch driver which named mtk_tpd.c

driver file

- path for touch common code: (e.g. mtk_tpd.c):
  - <kernel_ver>/drivers/input/touchscreen/mediatek
- driver for specific touch (e.g. gt1x_tpd.c) :
  - <kernel_ver>/drivers/input/touchscreen/mediatek/<tp_drv>
- coutomized touch driver file path(e.g. gt1x_tpd_custom.h)
  - <kernel_ver>/drivers/input/touchscreen/mediatek/<tp_drv>/include/<cust_folder>
  - set customized file path in kernel config
    - <kernel_ver>/arch/<arm_ver>/configs/

APIs used in touch(1)

- Use of_find_compatible_node to get your dts node, or use the probe callback of platform drivers to get populated dts node
- please make sure that return type of interrupt handler is irqreturn_t and must return with IRQ_HANDLED

```
struct of_device_id touch_of_match[] = {
    { .compatible = "mediatek,mt6570-touch", },
    { .compatible = "mediatek,mt6735-touch", },
```

```
node = of_find_matching_node(NULL, touch_of_match);
if (node) {
```

```
static irqreturn_t tpd_interrupt_handler(int irq, void *dev_id)
{
    if (irq_enabled) {
        irq_enabled = false;
        disable_irq_nosync(touch_irq);
    }
    tpd_flag = 1;
    wake_up_interruptible(&waiter);
    return IRQ_HANDLED;
}
```

APIs used in touch(2)

- Use irq_of_parse_and_map() to get virtual irq
- Use request_irq() instead to register IRQ
  - interrupt flag should be IRQF_TRIGGER_NONE, since irq_of_parse_and_map() already set trigger type, you can also overwrite the trigger type here)
- Use enable_irq()/disable_irq() to enable and disable irq
  - use disable_irq_nosync() in irq context instead
  - please make sure balance of enable_irq and disable_irq
  - default irq is enabled after request_irq, don't enable_irq again
- Use irq_set_irq_type() to change irq trigger type
- use enable_irq_wake() and disable_irq_wake() for irq with wakeup request

customize --- *Calibration*

- SW use the matrix to make touch coordinate match with LCM coordinate
  - <kernel_ver>/drivers/input/touchscreen/mediatek/<tp_drv>/include/<cust_folder>/ tpd_custom_gt9xx.h

```
#define TPD_CALIBRATION_MATRIX_ROTATION_NORMAL {4096,0,0,0,3686,0,0,0};
#define TPD_CALIBRATION_MATRIX_ROTATION_FACTORY {4096,0,0,0,3686,0,0,0};
```

A,B,C,D,E,F

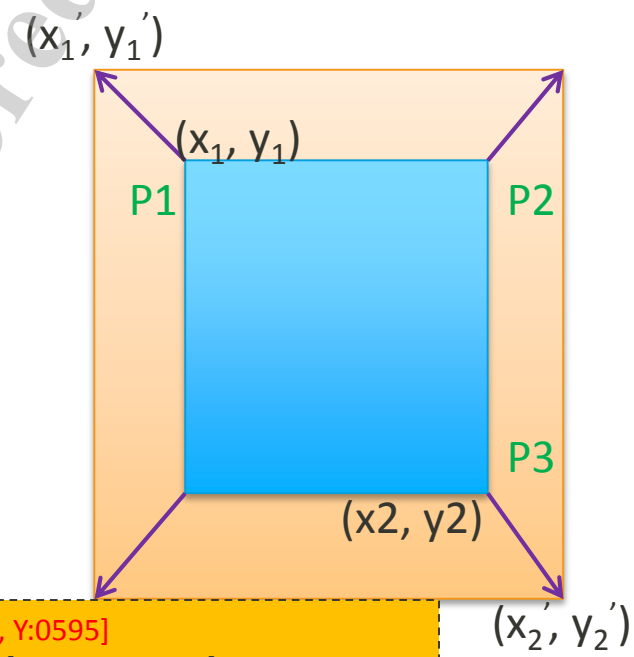
$$\begin{bmatrix} X' \\ Y' \end{bmatrix} = \frac{\begin{bmatrix} A & B & C \\ D & E & F \end{bmatrix}\begin{bmatrix} X \\ Y \\ 1 \end{bmatrix}}{4096}$$

$Ax + By + C = ResX * 4096$

$Dx + Ey + F = ResY * 4096$

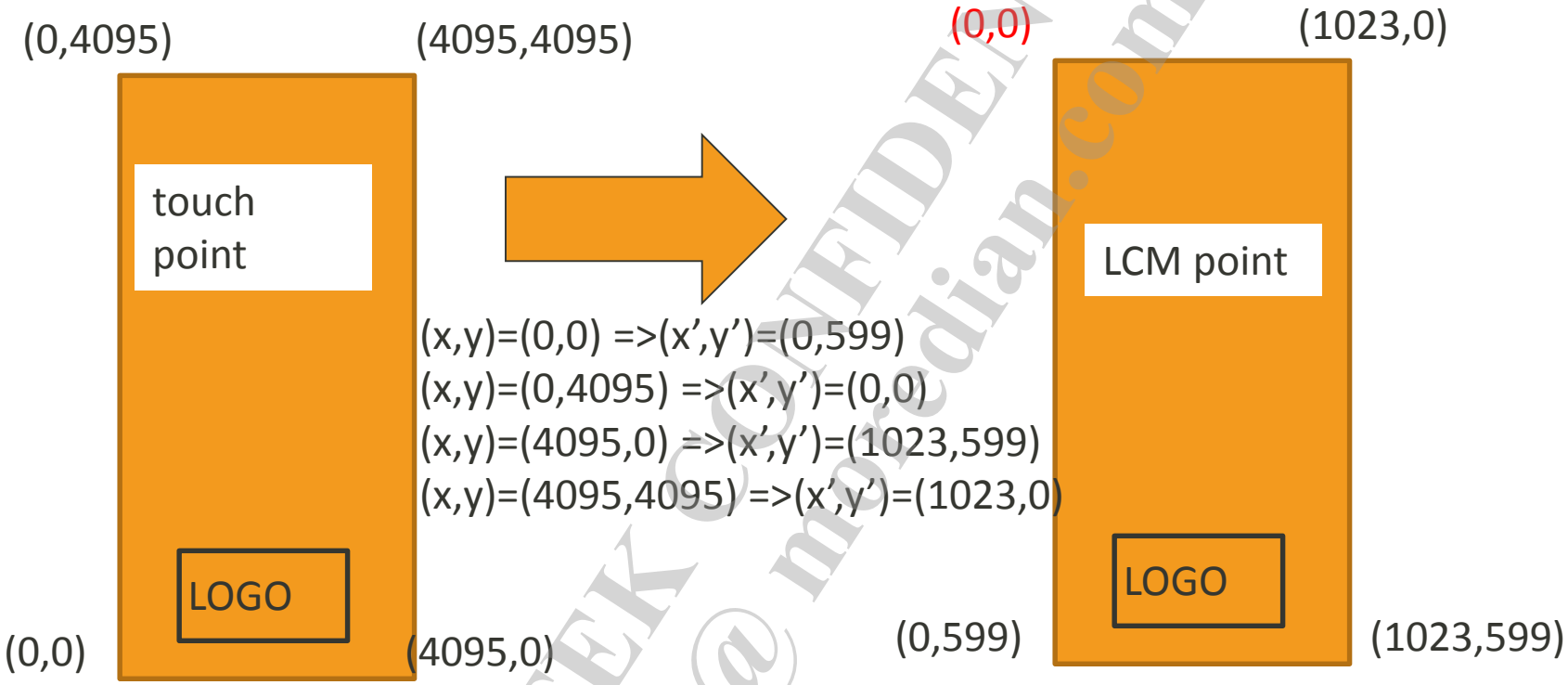
(X,Y): touch point, e.g. (0,0);(0,1280)…

(X',Y')=(ResX,ResY): LCM point



[63:mtk-tpd]<<-GTP-DEBUG->> [2284]Original touch coordinate: [X:0001, Y:0595]
[63:mtk-tpd]<<-GTP-DEBUG->> [2290]Touch coordinate after calibration: [X:0001, Y:0494]

customize—coordinate calibration



(x,y)=(0,0) =>(x',y')=(0,599)
(x,y)=(0,4095) =>(x',y')=(0,0)
(x,y)=(4095,0) =>(x',y')=(1023,599)
(x,y)=(4095,4095) =>(x',y')=(1023,0)

get 3 touch points for the formula

$Ax+By+C = resX * 4096$

$Dx+Ey+F = resY * 4096$

e.g.

$0A + 4095B + C = 0 * 4096$
$0A + 0B + C = 0 * 4096$
$4095A + 0B + C = 1023 * 4096$
result: A = 1023.25， B = 0， C = 0

$0D + 4095E + F = 0 * 4096$
$0D + 0E + F = 599 * 4096$
$4095D + 0E + F = 599 * 4096$
result: D = 0， E = -599.146， F = 2453504

Matrix => {1023,0,0,0,-599,2453504,0,0}

earyly suspend

- there is no early suspend, please use fb_notifier instead
- touch should wakelock itself when it want to wakeup the system
- code of fb_notifier is in mtk_tpd.c, it's not need to modify

```
static struct notifier_block tpd_fb_notifier;
/* use fb_notifier */
static void touch_resume_workqueue_callback(struct work_st
{
  TPD_DEBUG("GTP touch_resume_workqueue_callback\n");
  g_tpd_drv->resume(NULL);
  tpd_suspend_flag = 0;
}
static int tpd_fb_notifier_callback(struct notifier_block *self,
```

touch customization

configuration items

project configuration

- ProjectConfig.mk (device/mediatek/<proj>)
- check information:
  - CUSTOM_KERNEL_TOUCHPANEL = <tp_drv>
  - for Goodix hotknot supported touch, please set <tp_drv> as “GT9XX” for GT9XX series touch, and please set as “GT1XX” for GT1XX series touch

```
CUSTOM_KERNEL_SUB_LENS = dummy_lens
CUSTOM_KERNEL_TOUCHPANEL = GT9XX
```

GT9XX for GT9XX series that support hotknot

Kernel config

- kernel config file：
  - <proj>_debug_defconfig
  - <proj>_defconfig
- config file path：
  - 32 bits : <kernel_ver>/arch/arm/configs
  - 64 bits : <kernel_ver>/arch/arm64/configs
- check contents in config file
  - CONFIG_MTK_TOUCHPANEL=y
  - CONFIG_INPUT_TOUCHSCREEN=y
  - CONFIG_TOUCH_SCREEN_<tp_drv>=y
    - _<tp_drv> : shows the real touch driver you used, please refer to Kconfig file (<kernel_ver>/drivers/input/touchscreen/mediatek/Kconfig)

Kernel config

- Kconfig: shows which real touch driver is match to your config
  - <kernel_ver>/drivers/input/touchscreen/mediatek/Kconfig
  - e.g. CONFIG_TOUCHSCREEN_MTK_GT9XXTB_HOTKNOT=y, means the real touch driver is GT9XXTB_hotknot

```
config TOUCHSCREEN_MTK_GT9XXTB_HOTKNOT
  bool "GT9XXTB hotknot for Mediatek package"
  default n
  help
    Say Y here if you have GT9xx touch panel.

    If unsure, say N.

    To compile this dirver as a module, choose M here: the
    module will be called.

source "drivers/input/touchscreen/mediatek/GT9XXTB_hotknot/Kconfig"
```

real touch Driver path

Kernel config

- you should config customized file path in kernel config, please refer to Kconfig for add and update customized file
- step1： kernel config
  - CONFIG_<tp_drv>_FIRMWARE=“<cust_folder>”
  - CONFIG_<tp_drv>_CONFIG =“<cust_folder >”
  - e.g. :

```
CONFIG_GT9XXTB_FIRMWARE="firmware_default"
CONFIG_GT9XXTB_CONFIG="config_default"
```

<proj>_defconfig file

- step2: check Kconfig
  - path：<kernel_ver>/drivers/input/touchscreen/mediatek/<tp_drv>/Kconfig

```
config GT9XXTB_FIRMWARE
  string "GT9XXTB_hotknot for Mediatek firmware"

config GT9XXTB_CONFIG
  string "GT9XXTB_hotknot for Mediate
```

kernel config match with Kconfig

Kconfig file

Kernel config

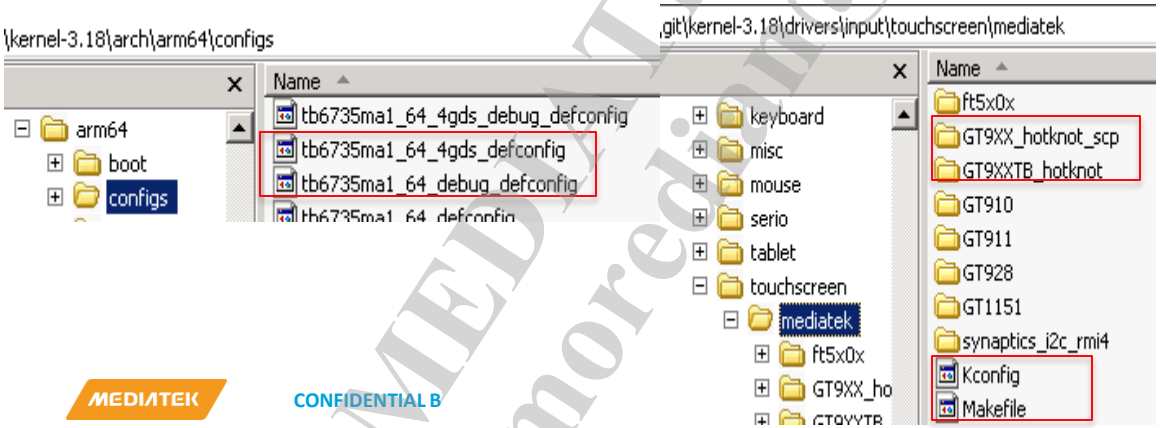
- Make file： check and add your customized file path
- path：<kernel_ver>/drivers/input/touchscreen/mediatek/<tp_drv>/makefile

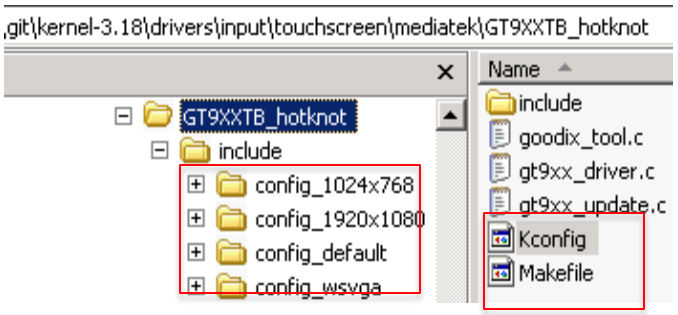
```
ccflags-y += -I$(srctree)/drivers/input/touchscreen/mediatek/GT9XXTB_hotknot/
ccflags-y += -I$(srctree)/drivers/input/touchscreen/mediatek/
ccflags-y += -I$(srctree)/drivers/input/touchscreen/mediatek/GT9XXTB_hotknot/include/$(CONFIG_GT9XXTB_FIRMWARE)/
ccflags-y += -I$(srctree)/drivers/input/touchscreen/mediatek/GT9XXTB_hotknot/include/$(CONFIG_GT9XXTB_CONFIG)/
ccflags-y += -I$(srctree)/drivers/misc/mediatek/include/mt-plat/
ccflags-y += -I$(srctree)/drivers/misc/mediatek/include/mt-plat/$(MTK_PLATFORM)/inclu

obj-y +=  gt9xx_driver.o
obj-y +=  goodix_tool.o
obj-y +=  gt9xx_update.o
```

make file

match with configs in the previous slide

- file and folder examples：





Kernel config

- config for specific touch driver

```
/*
#define GTP_CUSTOM_CFG          0
#define GTP_DRIVER_SEND_CFG     1
#define GTP_HAVE_TOUCH_KEY      0
```

maco marked in .h

```
CONFIG_TOUCHSCREEN_MTK=y
CONFIG_GTP_DRIVER_SEND_CFG=y
CONFIG_GTP_AUTO_UPDATE=y
CONFIG_GTP_HEADER_FW_UPDATE=y
CONFIG_GTP_CREATE_WR_NODE=y
```

kernel config

Kconfig also need relative settings

```
config GTP_DRIVER_SEND_CFG
  bool "GTP_DRIVER_SEND_CFG"
  default n
  help
  Say Y here if you have GT9XXTB_hotknot touch panel GTP_DEBUG_FUNC_ON.

  If unsure, say N.

  To compile this dirver as a module, choose M here: the
  module will be called.
```

touch customization

dws and dts

DWS file- I2C

- check i2c setting in dws file
  - <kernel_ver>/drivers/misc/mediatek/dws/<platfrom>/<proj>.dws
  - e.g. touch panel uses I2C id0
  - VarName1 should be
    - GPIO_I2C0_SDA_PIN
    - GPIO_I2C0_SDA_PIN

GPIO Setting | EINT Setting | ADC Setting | KEYPAD Setting | PMIC Setting | POWER Setting | MD1_EINT Setting

	Ei...	Def.Mode	M0	M1	M2	M3	M4	M5	M6	M7	In...	In...	D...	In	Out	O...	VarName1
GPIO84	☐	1:SDA0	☑	☑							☑	☑	IN	☑	☑	☐	GPIO_I2C0_SDA_PIN
GPIO85	☐	1:SCL0	☑	☑							☑	☑	IN	☑	☑	☐	GPIO_I2C0_SCA_PIN

- I2C address config

GPIO | EINT | ADC | KEYPAD | I2C | PMIC | ClockBuffer | POWER | MD1_EINT

Slave Device	Channel	Device Address
CAP_TOUCH	I2C_CHANNEL_1	0x5D

DWS file - CTP RST/EINT Pin

- RST Pin
  - VarName1 should be GPIO_CTP_RST_PIN

GPIO Setting | EINT Setting | ADC Setting | KEYPAD Setting | PMIC Setting | POWER Setting | MD1_EINT Setting

	Ei...	Def.Mode	M0	M1	M2	M3	M4	M5	M6	M7	In...	In...	D...	In	Out	O...	VarName1
GPIO13	☐	0:GPIO13	☑		☐		☐			☐	☐	☐	OUT	☐	☑	☐	GPIO_CTP_RST_PIN

- EINT Pin
  - check EINT mode
  - VarName1 should be GPIO_CTP_EINT_PIN

GPIO Setting | EINT Setting | ADC Setting | KEYPAD Setting | PMIC Setting | POWER Setting | MD1_EINT Setting

	Ei...	Def.Mode	M0	M1	M2	M3	M4	M5	M6	M7	In...	In...	D...	In	Out	O...	VarName1
GPIO10	☑	0:GPIO10									☑	☑	IN				GPIO_CTP_EINT_PIN

  - EINT setting: please refer to CTP spec for setting EINT setting,
  - note: please select **TOUCH for EINT Var**

GPIO | EINT | ADC | KEYPAD | I2C | PMIC | ClockBuffer | POWER | MD1_EINT

	EINT Var	Debounce Time (ms)	Polarity	Sensitive_Level	Debounce En
EINT9	NC	0			
EINT10	TOUCH	0	Low	Edge	Disable

please select TOUCH

dts file

- file path: <kernel_ver>/arch/<arm_ver>/boot/dts/<proj>.dts
  - please include platform dts file (< platform >.dtsi)
  - please include cust.dtsi (maybe had included in < platform >.dtsi , if so, doesn't need to include again in <proj>.dts)

```
#include "mt6735m.dtsi"
#include "tb6735ma1_64_bat_setting.dtsi"
#include "cust.dtsi"
```

- touch node:
  - root node: <kernel_ver>/arch/<arm_ver>/boot/dts/<platform>.dtsi
  - compatible string should match with software, SW use of_find_matching_node() read device tree information from dts file (mtk_tpd.c)
- note: device tree node name and compatible string should be lowercase

```
touch: touch@ {
  compatible = "mediatek,mt6735-touch",
               "mediatek,mt6735m-touch";
  vtouch-supply = <&mt_pmic_vgp1_ldo_reg>;
};
```

root node for touch

```
struct of_device_id touch_of_match[] = {
  { .compatible = "mediatek,mt6735-touch", },
  { .compatible = "mediatek,mt6580-touch", },
  { .compatible = "mediatek,mt8173-touch", },
  { .compatible = "mediatek,mt6755-touch", },
  { .compatible = "mediatek,mt6797-touch", },
  { .compatible = "mediatek,mt8163-touch", },
  {},
};

void tpd_get_dts_info(void)
{
  struct device_node *node1 = NULL;
  int key_dim_local[16], i;

  node1 = of_find_matching_node(node1, touch_of_match);
```

device tree node

- attach node for touch, <proj>.dts

```
&touch {
  tpd-resolution = <800 1280>;
  use-tpd-button = <0>;
  tpd-key-num = <3>;
  tpd-key-local= <139 172 158 0>;
  tpd-key-dim-local = <90 883 100 40 230 883 100 40 370 883 100 40 0 0 0 0>;
  tpd-max-touch-num = <5>;
  tpd-filter-enable = <1>;
  tpd-filter-pixel-density = <93>;
  tpd-filter-custom-prameters = <0 0 0 0 0 0 0 0 0 0 0 0>;
  tpd-filter-custom-speed = <0 0 0>;
  pinctrl-names = "default", "state_eint_as_int", "state_eint_output0", "state_eint_output1",
    "state_rst_output0", "state_rst_output1";
  pinctrl-0 = <&CTP_pins_default>;
  pinctrl-1 = <&CTP_pins_eint_as_int>;
  pinctrl-2 = <&CTP_pins_eint_output0>;
  pinctrl-3 = <&CTP_pins_eint_output1>;
  pinctrl-4 = <&CTP_pins_rst_output0>;
  pinctrl-5 = <&CTP_pins_rst_output1>;
  status = "okay";
};
```

touch that have keys

GPIO info, use pinctrl_lookup_state()to get the info, and use pinctrl_select_state() do GPIO setting

```
int tpd_get_gpio_info(struct platform_device *pdev)
{
    eint_output0 = pinctrl_lookup_state(pinctrl1, "state_eint_output0");

void tpd_gpio_output(int pin, int level
{
    pinctrl_select_state(pinctrl1, eint_output0);
```

dts node--Parameters Introduction

Parameter	Introduction	Comments
tpd_resolution[2]	touch panel resolution info for x and y axis	tpd_resolution[0]: LCM resolution of x axis tpd_resolution[1]: LCM resolution of y axis
use_tpd_button	define whether the touch panel use virtual key	1 stands for touch panel use touch virtual key 0 stands for touch panel not use touch virtual key
tpd_key_num	The number of the touch virtual key. you can not set this parameter if use_tpd_button is 0.	The max of the key number is 4.
tpd_key_local[4]	the Linux key value if touch virtual key is used, you can not set this parameter if use_tpd_button is 0.	fill in Linux key code which will use for virtual key on touch panel, layout from left to right corresponding to array value tpd_key_local[0], tpd_key_local[1], tpd_key_local[2], tpd_key_local[3]
tpd_key_dim_local[4] (include 4 parameters tpd_key_dim_local[4].key_x, tpd_key_dim_local[4].key_y, tpd_key_dim_local[4].key_width, tpd_key_dim_local[4].key_high)	the key layout info if touch virtual key is used, you can not set this parameter if use_tpd_button is 0.	every tpd_key_dim_local[i] corresponding to tpd_key_local[i] tpd_key_dim_local[i].key_x: location on x axis of tpd_key_local[i] tpd_key_dim_local[i].key_y: location on y axis of tpd_key_local[i] tpd_key_dim_local[i].key_width: width of tpd_key_local[i] tpd_key_dim_local[i].key_high: height of tpd_key_local[i]

device tree node

- attach node of touch--pinctrl
  - mainly check reset pin and EINT pin

```
&pio {
  CTP_pins_default: eint0default {
  };
 CTP_pins_eint_as_int: eint@0 {
   pins_cmd_dat {
     pins = <PINMUX_GPIO10__FUNC_GPIO10>;
     slew-rate = <0>;
     bias-disable;
   };
 };
 CTP_pins_eint_output0: eintoutput0 {
   pins_cmd_dat {
     pins = <PINMUX_GPIO10__FUNC_GPIO10>;
     slew-rate = <1>;
     output-low;
   };
 };
```

```
  CTP_pins_eint_output1: eintoutput1 {
    pins_cmd_dat {
      pins = <PINMUX_GPIO10__FUNC_GPIO10>;
      slew-rate = <1>;
      output-high;
    };
  };
  CTP_pins_rst_output0: rstoutput0 {
    pins_cmd_dat {
      pins = <PINMUX_GPIO62__FUNC_GPIO62>;
      slew-rate = <1>;
      output-low;
    };
  };
  CTP_pins_rst_output1: rstoutput1 {
    pins_cmd_dat {
      pins = <PINMUX_GPIO62__FUNC_GPIO62>;
      slew-rate = <1>;
      output-high;
    };
  };
};
/* TOUCH end */
```

mode is output and output High,please refer to pinctrl SOP

device tree node—I2C & EINT

- i2c and interrupt info for touch
  - modify dws, nodes as below in cust.dtsi will be generated by dws file
  - note: interrupt trigger type (e.g. IRQ_TYPE_EDGE_FALLING)should be the ones that defined int the following files
    - <kernel_ver>/include/dt-bindings/interrupt-controller/arm-gic.h
    - <kernel_ver>/include/dt-bindings/interrupt-controller/irq.h

```
&i2c0 {
    pinctrl-names = "default";
    pinctrl-0 = <&i2c0_pins_a>;
    status = "okay";

    cap_touch@38 {
        compatible = "mediatek,cap_touch";
        reg = <0x38>;
        interrupt-parent = <&pio>;
        interrupts = <46 IRQ_TYPE_EDGE_FALLING>;
        int-gpio = <&pio 35 0>;
        rst-gpio = <&pio 45 0>;
    };
```

Touch use I2C0, and slave address is 0x38

compatible info, SW use it to find the touch node in dts file, should same with SW.

EINT pin info, IRQ_TYPE_EDGE_FALLING can't be wrong

```
static const struct of_device_id tpd_of_match[] = {
    {.compatible = "mediatek,cap_touch"},
    {},
};
```

device tree node—I2C & EINT

- modify dws file is needed, nodes as below will be generated by dws file (cust.dtsi)
  - e.g. attach nodes in cust.dtsi(“&touch” means this is attach information of “touch” node）

```
&touch {
  interrupt-parent = <&eintc>;
  interrupts = <10 IRQ_TYPE_EDGE_FALLING>;
  debounce = <10 0>;
  status = "okay";
};
```

```
&touch {
  vtouch-supply = <&mt_pmic_vgp1_ldo_reg>;
  status = "okay";
};
```

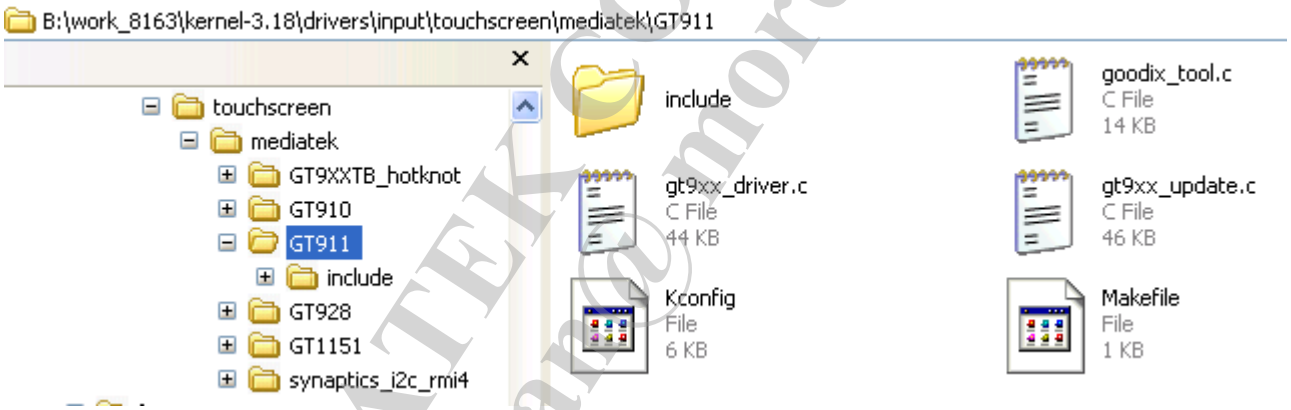
```
&i2c1 {
  #address-cells = <1>;
  #size-cells = <0>;
  cap_touch@5d {
    compatible = "mediatek,cap_touch";
    reg = <0x5d>;
    status = "okay";
  };
```

i2c info and compatible info of touch

Add a New Touch Driver

Touch Screen – Add New Driver (1/5)

- How to add a new touch driver in codebase
  - Path: ./<kernel_ver>/drivers/input/touchscreen/mediatek/
  - Add your driver source code.



Touch Screen – Add New Driver (2/5)

- Add the Makefile and Kconfig file driver needs, can be modeled on the other driver. Some customizable option defined here, too.

B:\work_8163\kernel-3.18\drivers\input\touchscreen\mediatek\GT911\Makefile

```
ccflags-y += -I$(srctree)/drivers/input/touchscreen/mediatek/
ccflags-y += -I$(srctree)/drivers/input/touchscreen/mediatek/GT911/include/$(CONFIG_GT911_FIRMWARE)/
ccflags-y += -I$(srctree)/drivers/input/touchscreen/mediatek/GT911/include/$(CONFIG_GT911_CONFIG)/
ccflags-y += -I$(srctree)/drivers/misc/mediatek/include/mt-plat/
ccflags-y += -I$(srctree)/drivers/misc/mediatek/include/mt-plat/$(MTK_PLATFORM)/include/

obj-y +=  goodix_tool.o
obj-y +=  gt9xx_driver.o
obj-y +=  gt9xx_update.o
```

B:\work_8163\kernel-3.18\drivers\input\touchscreen\mediatek\GT911\Kconfig

```
#
# Touchscreen driver configuration
#
if TOUCHSCREEN_MTK_GT911

config GT911_FIRMWARE
  string "GT911 for Mediatek firmware"

config GT911_CONFIG
  string "GT911 for Mediatek config"

config GTP_DRIVER_SEND_CFG
  bool "GT911 for Mediatek package"
  default n
```

Touch Screen – Add New Driver (3/5)

- Modify /<kernel_ver>/drivers/input/touchscreen/mediatek/Makefile. Add specific driver build option in Makefile.

B:\work_8163\kernel-3.18\drivers\input\touchscreen\mediatek\Makefile

```
obj-y   +=  mtk_tpd.o
obj-y   +=  tpd_button.o
obj-y   +=  tpd_calibrate.o
obj-y   +=  tpd_debug.o
obj-y   +=  tpd_default.o
obj-y   +=  tpd_init.o
obj-y   +=  tpd_misc.o
obj-y   +=  tpd_setting.o

obj-$(CONFIG_TOUCHSCREEN_MTK_GT1151)  +=  GT1151/
obj-$(CONFIG_TOUCHSCREEN_MTK_GT910) +=  GT910/
obj-$(CONFIG_TOUCHSCREEN_MTK_GT9XXTB_HOTKNOT) +=  GT9XXTB_hotknot/
obj-$(CONFIG_TOUCHSCREEN_MTK_SYNAPTICS_I2C_RMI4)  +=  synaptics_i2c_rmi4/
obj-$(CONFIG_TOUCHSCREEN_MTK_GT928) +=  GT928/
obj-$(CONFIG_TOUCHSCREEN_MTK_GT911) +=  GT911/
```

Touch Screen – Add New Driver (4/5)

- Modify /<kernel_ver>/drivers/input/touchscreen/mediatek/Kconfig. Add real driver config option in Kconfig.

B:\work_8163\kernel-3.18\drivers\input\touchscreen\mediatek\Kconfig

```
81
82 source "drivers/input/touchscreen/mediatek/GT910/Kconfig"
83
84 config TOUCHSCREEN_MTK_GT911
85   bool "GT1151 for Mediatek package"
86   default n
87   help
88   Say Y here if you have GT911 touch panel.
89
90   If unsure, say N.
91
92   To compile this dirver as a module, choose M here: the
93   module will be called.
94
95 source "drivers/input/touchscreen/mediatek/GT911/Kconfig"
96 endif
```

Touch Screen – Add New Driver (5/5)

- Modify <kernel_ver>/arch/<arm_ver>/configs/<proj>_defconfig
- Modify <kernel_ver>/arch/<arm_ver>/configs/<proj>_debug_defconfig)

B:\work_8163\kernel-3.18\arch\arm64\configs\tb8163m1_64_defconfig

```
# CONFIG_INPUT_KEYBOARD is not set
# CONFIG_INPUT_MOUSE is not set
CONFIG_INPUT_TOUCHSCREEN=y
CONFIG_TOUCHSCREEN_MTK=y
CONFIG_GTP_DRIVER_SEND_CFG=y
CONFIG_GTP_AUTO_UPDATE=y
CONFIG_GTP_HEADER_FW_UPDATE=y
CONFIG_GTP_CREATE_WR_NODE=y
CONFIG_GTP_POWER_CTRL_SLEEP=y
CONFIG_GTP_COMPATIBLE_MODE=y
CONFIG_TOUCHSCREEN_MTK_GT911=y
CONFIG_GT911_FIRMWARE="firmware1"
CONFIG_GT911_CONFIG="config1"
```

Touch Panel Driver Debug

Touch Panel Driver Debug

- confirm touch driver has been build in load
  - if no, check project config, kernel config, Makefile and Kconfig file
- check touch log
  - enable touch log : use “pr_err” for all log macro in driver, e.g.
    - #define GTP_DEBUG(fmt, arg...) pr_err("<<-GTP-DEBUG->> [%d]"fmt"\n", __LINE__, ##arg)
- check touch input event
  - use “adb shell getevent -i” to get input event number of “mtk-tpd”.
  - e.g. if “mtk-tpd” is event3, use “adb shell getevent /dev/input/event3” get touch input event.

```
[tpd_em_log] raw_x = 300, raw_y = 656, cal_x = 190, cal_y = 306, z1 = 154, z2 = 681, state = down (+10 ms)
[tpd_em_log] raw_x = 317, raw_y = 623, cal_x = 187, cal_y = 300, z1 = 162, z2 = 653, state = down (+10 ms)
```

Touch Panel Driver Debug

- touch input event type/code are shown as below table.

type	code	value
1=EV_KEY	0x14a(330) = BTN_TOUCH	Down=1, Up=0
3=EV_ABS	0x30(48) = ABS_MT_TOUCH_MAJOR	1
3=EV_ABS	0x35(53) = ABS_MT_POSITION_X	x=284
3=EV_ABS	0x36(54) = ABS_MT_POSITION_Y	y=366
3=EV_ABS	0x39(57) = ABS_MT_TRACKING_ID	point index=1
0=EV_SYN	0x2(2) = SYN_MT_REPORT	0
0=EV_SYN	0x0(0) = SYN_REPORT	0

Touch Panel Driver Debug

- check dws and dts setting with schematics
  - AVDD regulator configuration
  - check dws & dts for I2C info and interrupt information

```
cap_touch@38 {
    compatible = "mediatek,cap_touch";
    reg = <0x38>;
    interrupt-parent = <&pio>;
    interrupts = <46 IRQ_TYPE_EDGE_FALLING>;
    int-gpio = <&pio 35 0>;
    rst-gpio = <&pio 45 0>;
};
```

```
touch: touch {
    compatible = "mediatek,mt6735-touch";
    vtouch-supply = <&mt_pmic_vgp1_ldo_reg>;
};
```

power supply: regulator

I2C address info
interrupt and GPIO info

- software check
  - regulator control should balance bwtween enable and disable
    - regulator_set_voltage(), regulator_enable()……
  - use irq_of_parse_and_map() to get virtual irq
  - use request_irq() to register IRQ
  - enable_irq() should balance with disable_irq()

Touch Panel Driver Debug

- check the waveform of VDD/SCL/SDA/RESET/INT pins by scope to make sure touch IC works normally.
- For coordinate not match with LCM coordinate issue
  - check touch FW and customization table
  - check TPD_CALIBRATION_MATRIX
    - #define TPD_CALIBRATION_MATRIX_ROTATION_NORMAL
    - #define TPD_CALIBRATION_MATRIX_ROTATION_FACTORY

MEDIATEK

everyday genius