AN2491
Application note

STW8110x hardware component layer API guide

Introduction

Purpose and scope

This document describes the HCL elements of the STW8110x HCL API included in the STW8110x evaluation kit. This document is intended for people using the STW8110x digital bus interfaces. It proposes an abstraction of the hardware in order to allow a user to use all the facilities provided by the HW IP.

The document provides:

- A brief description of the hardware
- An overview of concepts on which the STW8110x HCL API is based
- A description and explanation of all API types and functions
- A user scenario
- The public header file

HCL API version

- Version of the STW8110x HCL API: **V1.0**
- Applicable to the IC: **STW8110x**

Contents

List of functions, constants, enums and structures

1 STW8110x API package

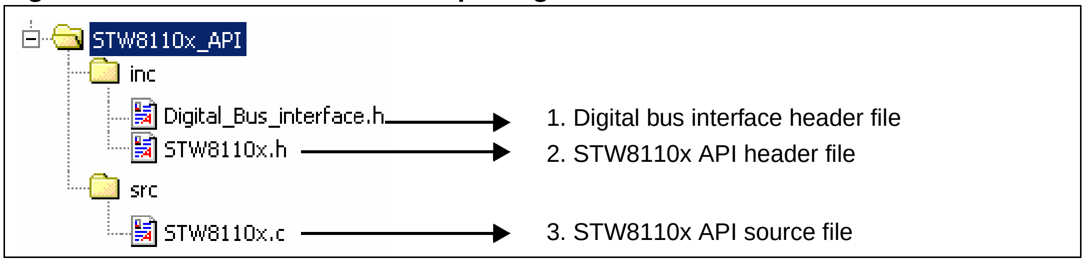
It is highly recommended to read the STW81101, STW81102 or STW81103 datasheet before continuing to read this document. This API is a simple abstraction of the principles presented in these datasheets.

The STW8110x device has two embedded digital bus interfaces (I^2C and SPI) which allow their internal registers to be programmed. Each of these interfaces has its own dedicated protocol which must be followed to program the device correctly. For details of the STW8110x register and SPI and I^2C protocols, refer to the relevant datasheet.

1.1 Content

Three files are available in this package. A fourth file must be created by the user with implementation of I^2C and SPI functions according to the master interface.

Figure 1. Files available with this package


STW8110x_API
inc
Digital_Bus_interface.h
STW8110x.h
src
STW8110x.c
1. Digital bus interface header file
2. STW8110x API header file
3. STW8110x API source file

1.1.1 Digital bus interface header file

Contains declarations of functions to be implemented by the user (refer to *Section 8* for a complete listing). This subsection describes the tasks that the functions must accomplish. For more details about the digital bus protocol flow and configuration to apply to your master interface (as frequency) please refer to the STW81101, STW81102 or STW81103 datasheet.

I^2C mode

```
t_I2C_Ack I2C_Send_data(unsigned char *data, int nb_bytes)
{
   // 1 - Send Start Bit
   // 2 - loop i=1 to i=nb_bytes
   //   a - send data[i]
   //   b - wait acknowledge of slave
   // 3 - Send Stop Bit
   // return ACK, or NO_ACK if acknowledge hasn't been received
}
```

```
t_I2C_Ack I2C_Read_data(unsigned char Add, unsigned char *data)

{
   // 1 - Send Start Bit
   // 2 - send Add
   // 3 - wait acknowledge of slave
```

```
    // 4 - read received data and affect it to *data
    // 3 - Send Stop Bit
    // return ACK, or NO_ACK if acknowledge hasn't been received
}
```

SPI mode

```
void SPI_Send_data(unsigned int data)
{
    // Send data (32bits) on SPI bus
}
```

1.1.2 STW8110x API header file

Contains declaration of functions, structures and defines necessary to the device driver. (Refer to *Section 7* for a complete listing).

1.1.3 STW8110x API source file

Contains the C code of device driver.

1.2 How to use the STW8110x API

1. Add the API in your project (STW8110x.c, STW8110x.h, Digital_Bus_interface.h).
2. Create a file (Digital_Bus_interface.c) with functions to implement according your master interface.
3. Include the STW8110x header file (#include “STW8110x.h”) in the file which uses the API functions.
4. Use dedicated functions to program the device (see examples in *Section 6*).

2 API overview

Note: To ensure the correct usage of this HCL API, it is HIGHLY recommended to use this API in the debug mode first (by use of __DEBUG preprocessor as described in Section 2.5). Only after the application has executed successfully in debug mode should the STW8110x driver be run in release mode.

The API contains 4 types of functions:

- Functions related to the global initialization of STW8110x
- Functions related to the configuration of STW8110x
- Functions related to extraction of the STW8110x configuration information
- Functions related to STW8110x debug management

2.1 Global initialization functions

STW8110x_Init(); initializes the data structures of the STW8110x HCL.

2.2 Configuration functions

Configure_STW8110x(); configures the STW8110x device.

2.3 Data extraction functions

- STW8110x_Check_config(); verifies selected configuration.
- STW8110x_Get_Fout_value(); gets output frequency according selected configuration.
- I2C_Read_Status_Register(); obtains information about read-only register (I^2C mode).

2.4 Debug management functions

STW8110x_ProcessError (); manages possible errors of the STW8110x device driver.

2.5 Driver targets and compilation options

The driver source files can work in several environments. There are three possible targets for which the driver compilation options (#define) customize the code for the target.

- The platform - represents the IC (STW81101, STW81102, STW81103).
- The interface - represents digital interface used to program the device (I^2C, SPI).
- The mode - identifies if the code is being compiled for debug or release mode.

Table 1. Target platform compilation options

Platform	STW81101	STW81102	STW81103
#define	__PLATFORM_STW81101	__PLATFORM_STW81102	__PLATFORM_STW81103

Table 2. Target interface compilation options

Interface	I^2C	SPI
#define	__INTERFACE_I2C	__INTERFACE_SPI

Table 3. Target mode compilation options

Mode	Debug	Release
#define	__DEBUG	__NO_DEBUG

3 Constants and enums

3.1 Both modes

t_PD

Defines the device functional mode.

```
typedef enum
{
   POWER_DOWN,
   VCO_A_FREQ_DIV_2,
   VCO_B_FREQ_DIV_2,
   VCO_EXT_FREQ_DIV_2,
   VCO_A_FREQ_DIV_4,
   VCO_B_FREQ_DIV_4,
   VCO_EXT_FREQ_DIV_4,
   VCO_A_DIRECT_OUTPUT,
   VCO_B_DIRECT_OUTPUT,
   VCO_EXT_DIRECT_OUTPUT
} t_PD;
```

t_SERCAL

Defines the VCO auto-calibration status.

```
typedef enum
{
   VCO_CAL_DISABLED,
   VCO_CAL_ENABLED
} t_SERCAL;
```

t_CP_SEL

Defines the charge pump current

```
typedef enum
{
   CURRENT_I_MIN,
   CURRENT_2_I_MIN,
   CURRENT_3_I_MIN,
   CURRENT_4_I_MIN,
   CURRENT_5_I_MIN,
   CURRENT_6_I_MIN,
   CURRENT_7_I_MIN,
   CURRENT_8_I_MIN
} t_CP_SEL;
```

t_PSC_SEL

Defines the prescaler modulus.

```
typedef enum
{
   PRESCALER_16,
   PRESCALER_19
} t_PSC_SEL;
```

t_PLL_A

Defines the PLL amplitude voltage of VCO.

```
typedef enum
{
   AMPL_1V1,
   AMPL_1V3,
   AMPL_1V9,
   AMPL_2V1
} t_PLL_A;
```

t_stw8110x_error

Defines all errors that can be returned by the functions of the STW8110x HCL API.

```
typedef enum
{
   OK                              = 0,
   ERR_A_HIGHER_THAN_B             = -113,
   ERR_A_OUTOF_RANGE           ,// = -112,
   ERR_B_OUTOF_RANGE           ,// = -111,
   ERR_N_OUTOF_RANGE           ,// = -110,
   ERR_VCOA_FREQ_OUTOF_RANGE ,// = -109,
   ERR_VCOB_FREQ_OUTOF_RANGE ,// = -108,
   ERR_FUNCT_MODE_UNKNOWN      ,// = -107,
   ERR_REF_CLK_DIVIDER         ,// = -106,
   ERR_PRESCALER               ,// = -105,
   ERR_VCO_CALIBRATION         ,// = -104,
   ERR_VCO_VOLTAGE             ,// = -103,
   #ifdef __INTERFACE_I2C
      ERR_I2C_ACK              ,// = -102,
      ERR_BAD_DEVICE           ,// = -101,
      ERR_I2C_READ             ,// = -100,
   #endif                      //__INTERFACE_I2C
   ERR_CHARGE_PUMP_CURRENT     // = -99 or -102
} t_stw8110x_error ;
```

3.2 I^{2}C mode

t_stw8110x_Device_Type

Defines the device name.

```
typedef enum
{
   DEV_STW81101,
   DEV_STW81102,
   DEV_STW81103
} t_stw8110x_Device_Type ;
```

t_stw8110x_PLL_Status

Defines the status of PLL.

```
typedef enum
{
   PLL_UNLOCKED,
   PLL_LOCKED
} t_stw8110x_PLL_Status ;
```

4 Structures

4.1 Both modes

t_stw8110x_Registers

Defines the structure of STW8110x registers.

```
typedef struct
{
  #ifdef __INTERFACE_I2C
    t_uint8 REG0; // Functional modes
    t_uint8 REG1; // B counter
    t_uint8 REG2; // A counter
    t_uint8 REG3; // Reference divider
    t_uint8 REG4; // Control
    t_uint8 REG5; // Calibration
    t_uint8 REGRO; // Read only register: internal calibration of
//                     VCO, PLL state (locked,unlocked), Device ID
  #endif          //__INTERFACE_I2C
  #ifdef __INTERFACE_SPI
//   ST1: reference divider, VCO amplitude, VCO Calibration,
//   Charge Pump current, Prescaler Modulus
    t_uint32 ST1;
//   ST2: Functional modes, VCO dividers
// __INTERFACE_SPI
  #endif
  t_uint32 ST2;
} t_stw8110x_Registers ;
```

t_stw8110x_Config

Defines the structure that holds essential transfer parameters for device configuration.

```
typedef struct
{
  t_bool      DEFAULT_CONFIG;
  t_SERCAL    VCO_CALIBRATION_EN;
  t_PD        DEVICE_FUNCTIONAL_MODE;
  t_uint32    MAIN_COUNTER;
  t_uint32    SWALLOW_COUNTER;
  t_uint32    REF_CLOCK_DIV_RATIO;
  t_PLL_A     VCO_AMPLITUDE_VOLTAGE;
  t_CP_SEL    CHARGE_PUMP_CURRENT;
  t_PSC_SEL   PRESCALER_MODULUS;
} t_stw8110x_Config ;
```

Note: If the field DEFAULT_CONFIG is marked as BOOL_TRUE then the remaining fields following it may not be used and may not be filled up. Instead the default configuration for the device (as programmed in STW8110x_Init) will be used. The default configuration is described in the STW81101, STW81102 and STW81103 datasheets.

4.2 I^{2}C mode

t_stw8110x_I2C_RO_reg

Defines the structure of STW8110x read-only register.

```
typedef struct
{
  t_stw8110x_Device_Type  DEV_TYPE; // Device identifier bit
  t_stw8110x_PLL_Status   LOCK_DET; // '1' when PLL is locked
  t_uint8                 INT_CAL; //VCO ctrl word internal value
} t_stw8110x_I2C_RO_reg ;
```

5 Functions

STW8110x has 3 bits which are programmable in I^{2}C mode. This means that eight STW8110x devices should be connected to the same I^{2}C master.

The choice of device is performed via the 3 programmable address bits (A2, A1, A0 set to 0V (0) or 3.3V (1)). This is why, if I^{2}C mode is selected, some functions require a supplementary parameter which specifies the address of the device to access I2C_ADD (0 to 7).

5.1 Both modes

STW8110x_Init()

Description	Initializes the STW8110x HCL.

Definition	`t_stw8110x_error STW8110x_Init(`
	`t_stw8110x_Config *Device_config_init`
	`#ifdef __INTERFACE_I2C`
	`,t_uint8 I2C_ADD`
	`#endif`
	`);`

Arguments Both modes (out) I^{2}C mode (in)	`Device_config_init`: Structure containing default config of device `I2C_ADD`: Address of STW8110x device (only I^{2}C mode)
Return value	`t_stw8110x_error`
FunctionType	Synchronous
Comments	Potential errors: – Both modes: `OK`, – I^{2}C modes: `ERR_BAD_DEVICE`, `ERR_I2C_ACK`, `ERR_I2C_READ` The routine initializes the device configuration descriptor. If I^{2}C mode is selected, a read of the read only register is performed to check if the selected target matches with the accessed device.

Configure_STW8110x()

Description	Configures the STW8110x device.

Definition	`t_stw8110x_error Configure_STW8110x(`
	`t_stw8110x_Config Device_config_init`
	`#ifdef __INTERFACE_I2C`
	`,t_uint8 I2C_ADD`
	`#endif`
	`);`

Arguments Both modes(out) I^{2}C mode (in)	 `Device_config_init`: Structure containing configuration of device `I2C_ADD`: Address of STW8110x device (only I^{2}C mode)
Return value	`t_stw8110x_error`
FunctionType	Synchronous

Comments	Potential errors:
	– Both modes:
	`OK,`
	`ERR_VCO_CALIBRATION,`
	`ERR_FUNCT_MODE_UNKNOWN,`
	`ERR_VCO_VOLTAGE,`
	`ERR_CHARGE_PUMP_CURRENT,`
	`ERR_PRESCALER,`
	`ERR_A_HIGHER_THAN_B,`
	`ERR_A_OUTOF_RANGE,`
	`ERR_B_OUTOF_RANGE,`
	`ERR_REF_CLK_DIVIDER,`
	`ERR_N_OUTOF_RANGE,`
	– I^{2}C modes:
	`ERR_I2C_ACK`
	During this routine, a check of the device configuration (using the STW8110x_Check_config function) is performed before configuring the registers.

STW8110x_Check_config()

Description	Checks the configuration selected with device specification.

Definition	`t_stw8110x_error STW8110x_Check_config(`
	`t_stw8110x_Config Device_config`
	`);`

Arguments (in)	`Device_config`: Structure containing configuration of device
Return value	`t_stw8110x_error`
FunctionType	Synchronous

Comments	Potential errors:
	`OK,`
	`ERR_VCO_CALIBRATION,`
	`ERR_FUNCT_MODE_UNKNOWN,`
	`ERR_VCO_VOLTAGE,`
	`ERR_CHARGE_PUMP_CURRENT,`
	`ERR_PRESCALER,`
	`ERR_A_HIGHER_THAN_B,`
	`ERR_A_OUTOF_RANGE,`
	`ERR_B_OUTOF_RANGE,`
	`ERR_REF_CLK_DIVIDER,`
	`ERR_N_OUTOF_RANGE`

STW8110x_Get_Fout_value()

Description	Returns output frequency according to the selected configuration and the input frequency.

Definition	`t_stw8110x_error STW8110x_Get_Fout_value(`
	`t_stw8110x_Config Device_config_init,`
	`double Fref_clk,`
	`double *Fout_MHz`
	`);`

Arguments (in) (in) (out)	`Device_config_init`: Structure containing configuration of device `Fref_clk`: Input frequency in MHz `Fout_MHz`: Output frequency in MHz
Return value	`t_stw8110x_error`
FunctionType	Synchronous

Comments	Potential errors:
	`OK,`
	`ERR_VCO_CALIBRATION,`
	`ERR_FUNCT_MODE_UNKNOWN,`
	`ERR_VCO_VOLTAGE,`
	`ERR_CHARGE_PUMP_CURRENT,`
	`ERR_PRESCALER,`
	`ERR_A_HIGHER_THAN_B,`
	`ERR_A_OUTOF_RANGE,`
	`ERR_B_OUTOF_RANGE,`
	`ERR_REF_CLK_DIVIDER,`
	`ERR_N_OUTOF_RANGE,`
	`ERR_VCOA_FREQ_OUTOF_RANGE,`
	`ERR_VCOB_FREQ_OUTOF_RANGE`

STW8110x_ProcessError()

Description	Manages the STW8110x device driver errors.

Definition	`void STW8110x_ProcessError(`
	`t_stw8110x_error error`
	`);`

Arguments (in)	`error`: error returned by functions of API
Return value	none
FunctionType	Synchronous

5.2 I²C mode

I2C_Read_Status_Register()

Description	Returns the value of the STW8110x read only register.

Definition	`t_stw8110x_error I2C_Read_Status_Register(`
	`t_stw8110x_I2C_RO_reg *ReadOnlyReg,`
	`t_uint8 I2C_ADD`
	`);`

Arguments (out) (in)	`ReadOnlyReg`: Structure containing value of read only register `I2C_ADD`: Address of the STW8110x device
Return value	`t_stw8110x_error`
FunctionType	Synchronous

Comments	Potential errors:
	`OK,`
	`ERR_I2C_ACK,`
	`ERR_I2C_READ`

6 User scenarios

6.1 I²C mode

```
// Device address define
#define DEVICE_ADD 0x1 // A2=0, A1=0, A0=1
// STW8110x declaration
t_stw8110x_Config Device_config;
t_stw8110x_error st_error;
double Fout;
t_stw8110x_I2C_RO_reg ReadOnlyReg;

// Device Driver Initilization
st_error = STW8110x_Init(&Device_config, DEVICE_ADD);
if(st_error != OK)
{
  STW8110x_ProcessError(st_error);
}
//******* Configuration I **********
// Set configuration structure of device
// Default config is selected
Device_config.DEFAULT_CONFIG = BOOL_TRUE;
// Configure the device
st_error = Configure_STW8110x(Device_config, DEVICE_ADD);
if(st_error != OK)
{
  STW8110x_ProcessError(st_error);
}
//******* Configuration II **********
// Set configuration structure of device.
// Config is set to ouput frequency 843.75MHz, reference clock 60MHz
Device_config.DEFAULT_CONFIG = BOOL_FALSE;
Device_config.DEVICE_FUNCTIONAL_MODE = VCO_A_FREQ_DIV_4;
Device_config.VCO_CALIBRATION_EN = VCO_CAL_ENABLED;
Device_config.SWALLOW_COUNTER = 8;
Device_config.MAIN_COUNTER = 562;
Device_config.REF_CLOCK_DIV_RATIO = 160;
Device_config.VCO_AMPLITUDE_VOLTAGE = AMPL_2V1;
Device_config.CHARGE_PUMP_CURRENT = CURRENT_8_I_MIN;
Device_config.PRESCALER_MODULUS = PRESCALER_16;
// Configure the device
st_error = Configure_STW8110x(Device_config, DEVICE_ADD);
if(st_error != OK)
{
  STW8110x_ProcessError(st_error);
}
// Get output frequency(MHz) according config and reference clock
st_error = STW8110x_Get_Fout_value(Device_config,60,&Fout);
if(st_error != OK)
{
  STW8110x_ProcessError(st_error);
}
printf("With selected configuration and input freq=60MHz, output
Freq = %fMHz\n",Fout);
// Reading Read Only register of device
st_error = I2C_Read_Status_Register(&ReadOnlyReg, DEVICE_ADD);
if(st_error != OK)
{
  STW8110x_ProcessError(st_error);
}
printf("Device Read Only Register Status:\n");
printf("Device ID : %d\n", ReadOnlyReg.DEV_TYPE);
printf("PLL: %s\n", (ReadOnlyReg.LOCK_DET)?"Locked":"Unlocked");
printf("Internal VCO value: %d\n", ReadOnlyReg.INT_CAL);
// Note: If you have selected the DEBUG mode, information is
// automatically displayed, so no printf is needed
```

6.2 SPI mode

```
// STW8110x declaration
t_stw8110x_Config Device_config;
t_stw8110x_error st_error;
double Fout;
// Device Driver Initilization
STW8110x_Init(&Device_config);
//******* Configuration I **********
// Set configuration structure of device
// Config set to ouput frequency 4467.1875MHz reference clock 60MHz
Device_config.DEFAULT_CONFIG = BOOL_FALSE;
Device_config.DEVICE_FUNCTIONAL_MODE = VCO_B_DIRECT_OUTPUT;
Device_config.VCO_CALIBRATION_EN = VCO_CAL_ENABLED;
Device_config.SWALLOW_COUNTER = 11;
Device_config.MAIN_COUNTER = 501;
Device_config.REF_CLOCK_DIV_RATIO = 128;
Device_config.VCO_AMPLITUDE_VOLTAGE = AMPL_2V1;
Device_config.CHARGE_PUMP_CURRENT = CURRENT_8_I_MIN;
Device_config.PRESCALER_MODULUS = PRESCALER_19;
st_error = STW8110x_Get_Fout_value(Device_config,60,&Fout);
if(st_error != OK)
{
   STW8110x_ProcessError(st_error);
}
// Configure the device
st_error = Configure_STW8110x(Device_config);
if(st_error != OK)
{
   STW8110x_ProcessError(st_error);
}
//******* Config II: Set in Power Down mode **********
// Set configuration structure of device
   Device_config.DEFAULT_CONFIG = BOOL_FALSE;
   Device_config.DEVICE_FUNCTIONAL_MODE = POWER_DOWN;
// Configure the device
st_error = Configure_STW8110x(Device_config);
if(st_error != OK)
{
   STW8110x_ProcessError(st_error);
}
```

7 STW8110x public header file

```
//*******************************************************************
// Copyright (C) 2006 STMicroelectronics
// File name:STW8110x.h
// Description:Header file for SPI/I2C STW8110x Interface Driver
// code. Provides function type and data structure definition
// Creation:11/20/2006
//*******************************************************************
#ifndef _STW8110x_H
#define _STW8110x_H
//*******************************************************************
// -------Preprocessor Checking-------
//*******************************************************************
#if !( defined(__PLATFORM_STW81101) | defined(__PLATFORM_STW81102)
| defined(__PLATFORM_STW81103))
 #error "__PLATFORM_STW81101, __PLATFORM_STW81102 or
__PLATFORM_STW81103 must be defined"
#endif
#if !( defined(__INTERFACE_I2C) | defined(__INTERFACE_SPI))
 #error "Either of __INTERFACE_I2C or __INTERFACE_SPI must be
defined"
#endif
#if !( defined(__NO_DEBUG) | defined(__DEBUG))
 #error "Either of __NO_DEBUG or __DEBUG must be defined"
#endif
//*******************************************************************
// -------Allowing C++ to use these headers-------
//*******************************************************************
#ifdef__cplusplus
extern "C" {
#endif // __cplusplus
//*******************************************************************
// -------miscellaneous-------
//*******************************************************************
//-------------------------------------------------------------------
// Type definition
//-------------------------------------------------------------------
typedef unsigned int t_uint32;
typedef unsigned char t_uint8;
//-------------------------------------------------------------------
// Type enumeration
//-------------------------------------------------------------------
typedef enum {BOOL_FALSE, BOOL_TRUE} t_bool;
//-------------------------------------------------------------------
// Constants
//-------------------------------------------------------------------
#define REG_CLEAR0x00000000
#define ZERO0x0
```

```
//-----------------------------------------------------------------
// Macros dedicated to build, set, get bits of registers
//-----------------------------------------------------------------
#define mREG_SET(__datum, __val) ((__datum) = (t_uint32)(__val))
#define mBYTE_SET(__datum, __val) ((__datum) = (t_uint8)(__val))
#define mBIT_MASK(__bws)
((t_uint32)(((bw##__bws)==32)?0xFFFFFFFF:((1 << (bw##__bws)) - 1))
<< (bs##__bws))
#define mBIT_BUILD(__bws, __val) ((t_uint32)(((t_uint32)(__val) <<
(t_uint32)(bs##__bws)) & ((t_uint32) mBIT_MASK(__bws))))
#define mBIT_GET(__datum, __bws) ((t_uint32)(((__datum) &
((t_uint32) mBIT_MASK(__bws))) >> (bs##__bws)))
#define mBIT_SET(__datum, __bws, __val) ((__datum) = ((t_uint32)
(__datum) & (t_uint32)~(mBIT_MASK(__bws))) | ((t_uint32)
((t_uint32)(__val) << (t_uint32)(bs##__bws)) & (mBIT_MASK(__bws))))
//-----------------------------------------------------------------
// Macros dedicated to print a string (depends of debug mode)
//-----------------------------------------------------------------
#ifdef __DEBUG
  #include "stdio.h"
  #define DBGPRINT(str)          printf(str)
  #define DBGPRINT1(str,a)       printf(str,a)
  #define DBGPRINT2(str,a,b)     printf(str,a,b)
  #define DBGPRINT3(str,a,b,c)   printf(str,a,b,c)
#else
  #ifdef __NO_DEBUG
    #define DBGPRINT(str)
    #define DBGPRINT1(str,a)
    #define DBGPRINT2(str,a,b)
    #define DBGPRINT3(str,a,b,c)
  #endif  // __NO_DEBUG
#endif    //__DEBUG
//*****************************************************************
// -------STW8110x Frequency range-------
//*****************************************************************
#ifdef __PLATFORM_STW81101
  #define VCO_A_FREQ_MIN 3300
  #define VCO_A_FREQ_MAX 3900
  #define VCO_B_FREQ_MIN 3800
  #define VCO_B_FREQ_MAX 4400
#elif __PLATFORM_STW81102
  #define VCO_A_FREQ_MIN 3000
  #define VCO_A_FREQ_MAX 3620
  #define VCO_B_FREQ_MIN 4000
  #define VCO_B_FREQ_MAX 4650
#elif __PLATFORM_STW81103
  #define VCO_A_FREQ_MIN 2500
  #define VCO_A_FREQ_MAX 3050
  #define VCO_B_FREQ_MIN 4350
  #define VCO_B_FREQ_MAX 5000
#endif
```

```
//******************************************************************
// -------STW8110x Device Address / access mode-------
//******************************************************************
#ifdef __INTERFACE_I2C
  #define I2C_DEVICE_MSB_ADD 0xC0
  #define I2C_READ 1
  #define I2C_WRITE 0
  #define REG0_ADD 0x00
  #define REG1_ADD 0x01
  #define REG2_ADD 0x02
  #define REG3_ADD 0x03
  #define REG4_ADD 0x04
  #define REG5_ADD 0x05
#endif //__INTERFACE_I2C
#ifdef __INTERFACE_SPI
  #define ST1_ADD 0x00
  #define ST2_ADD 0x01
  #define SHIFT_ADD 24
#endif //__INTERFACE_SPI
//******************************************************************
// -------STW8110x Enumeration Types-------
//******************************************************************
// STW8110x errors
typedef enum
{
  OK                          = 0,
  ERR_A_HIGHER_THAN_B         = -113,
  ERR_A_OUTOF_RANGE           ,// = -112,
  ERR_B_OUTOF_RANGE           ,// = -111,
  ERR_N_OUTOF_RANGE           ,// = -110,
  ERR_VCOA_FREQ_OUTOF_RANGE ,// = -109,
  ERR_VCOB_FREQ_OUTOF_RANGE ,// = -108,
  ERR_FUNCT_MODE_UNKNOWN ,// = -107,
  ERR_REF_CLK_DIVIDER         ,// = -106,
  ERR_PRESCALER               ,// = -105,
  ERR_VCO_CALIBRATION         ,// = -104,
  ERR_VCO_VOLTAGE             ,// = -103,
  #ifdef __INTERFACE_I2C
    ERR_I2C_ACK               ,// = -102,
    ERR_BAD_DEVICE            ,// = -101,
    ERR_I2C_READ              ,// = -100,
  #endif                       //__INTERFACE_I2C
  ERR_CHARGE_PUMP_CURRENT      // = -99 or -102
} t_stw8110x_error ;
//
// Prescaler modulus definition
//
typedef enum {
  PRESCALER_16,
  PRESCALER_19
} t_PSC_SEL;
```

```
//
// VCO calibration enabling definition
//
typedef enum {
  VCO_CAL_DISABLED,
  VCO_CAL_ENABLED
} t_SERCAL;
//
// Device Functional modes definition
//
typedef enum {
  CURRENT_I_MIN,
  CURRENT_2_I_MIN,
  CURRENT_3_I_MIN,
  CURRENT_4_I_MIN,
  CURRENT_5_I_MIN,
  CURRENT_6_I_MIN,
  CURRENT_7_I_MIN,
  CURRENT_8_I_MIN
} t_CP_SEL;
//
//VCO Voltage Amplitude definition
//
typedef enum {
  AMPL_1V1,
  AMPL_1V3,
  AMPL_1V9,
  AMPL_2V1
} t_PLL_A;
//
// Device Functional modes definition
//
typedef enum {
  POWER_DOWN,
  VCO_A_FREQ_DIV_2,
  VCO_B_FREQ_DIV_2,
  VCO_EXT_FREQ_DIV_2,
  VCO_A_FREQ_DIV_4,
  VCO_B_FREQ_DIV_4,
  VCO_EXT_FREQ_DIV_4,
  VCO_A_DIRECT_OUTPUT,
  VCO_B_DIRECT_OUTPUT,
  VCO_EXT_DIRECT_OUTPUT
} t_PD;
#ifdef __INTERFACE_I2C
  //
  // Definition of the STW8110x Device Type
  //
  typedef enum
  {
    DEV_STW81101,
    DEV_STW81102,
    DEV_STW81103
} t_stw8110x_Device_Type ;
  //
  // Definition of the STW8110x PLL lock status
  //
  typedef enum
  {
    PLL_LOCKED,
    PLL_UNLOCKED
  } t_stw8110x_PLL_Status ;
#endif //__INTERFACE_I2C
//*******************************************************************
// -------STW8110x Structure types-------
//*******************************************************************
//
// Definition of the STW8110x reg descriptor structure
//
typedef struct
{
  #ifdef __INTERFACE_I2C
    t_uint8 REG0; // Functional modes
    t_uint8 REG1; // B counter
    t_uint8 REG2; // A counter
    t_uint8 REG3; // Reference divider
    t_uint8 REG4; // Control
    t_uint8 REG5; // Calibration
    t_uint8 REGRO; // Read only register: internal calibration of
                   //VCO, PLL state (locked,unlocked), Device ID
  #endif //__INTERFACE_I2C
  #ifdef __INTERFACE_SPI
//   ST1: reference divider, VCO amplitude, VCO Calibration, Charge
//   Pump current, Prescaler Modulus
    t_uint32 ST1;
//   ST2: Functional modes, VCO dividers
    t_uint32 ST2;
  #endif // __INTERFACE_SPI
} t_stw8110x_Registers ;
//
// Definition of the STW8110x configuration descriptor structure
//
typedef struct
{
  t_bool    DEFAULT_CONFIG;
  t_SERCAL  VCO_CALIBRATION_EN;
  t_PD      DEVICE_FUNCTIONAL_MODE;
  t_uint32  MAIN_COUNTER;
  t_uint32  SWALLOW_COUNTER;
  t_uint32  REF_CLOCK_DIV_RATIO;
  t_PLL_A   VCO_AMPLITUDE_VOLTAGE;
  t_CP_SEL  CHARGE_PUMP_CURRENT;
  t_PSC_SEL PRESCALER_MODULUS;
} t_stw8110x_Config ;
```

```
#ifdef __INTERFACE_I2C
//
// Definition of the STW8110x I2C ReadOnly register
  typedef struct
  {
    t_stw8110x_Device_TypeDEV_TYPE; // Device identifier bit
    t_stw8110x_PLL_StatusLOCK_DET; // '1' when PLL is locked
    t_uint8   INT_CAL; // internal value of VCO control word
  } t_stw8110x_I2C_RO_reg ;
#endif //__INTERFACE_I2C
//*******************************************************************
// -------STW8110x Hardware Access Definitions-------
//*******************************************************************
#ifdef __INTERFACE_SPI
// Description:
// ST1 - reference divider, VCO amplitude, VCO Calibration,
// Charge Pump current,Prescaler Modulus
//
  #define bwREF_CLK_DIV_RATIO  10 // Reference clock divider ratio
  #define bwPLL_A          2 // VCO Amplitude control
  #define bwCPSEL          3 // charge pump output current control
  #define bwPSC_SEL        1 // Prescaler modulus select
  #define bwINITCAL        1 // Test purpose only,must be set to 0
  #define bwSERCAL         1 // VCO Calibration Enable
  #define bwSELEXTCAL      1 // Test purpose only,must be set to 0
  #define bwCAL            5 // Test purpose only,must be set to 0
  #define bsREF_CLK_DIV_RATIO 14 // Reference clock divider ratio
  #define bsPLL_A          12 // VCO Amplitude control
  #define bsCPSEL          9 // charge pump output current control
  #define bsPSC_SEL        8 // Prescaler modulus select
  #define bsINITCAL        7 // Test purpose only,must be set to 0
  #define bsSERCAL         6 // VCO Calibration Enable
  #define bsSELEXTCAL      5 // Test purpose only,must be set to 0
  #define bsCAL            0 // Test purpose only,must be set to 0
//
// Description:
// ST2 - Functional modes, VCO dividers
//
  #define bwPD             7 // Functional mode
  #define bwcount_B        12// swallow counter
  #define bwcount_A        5 // main counter
  #define bsPD             17// Functional mode
  #define bscount_B        5 // swallow counter
  #define bscount_A        0 // main counter
#endif //__INTERFACE_SPI
#ifdef __INTERFACE_I2C
// REG0
  #define bwPD             7 // Reference clock divider ratio
  #define bwcount_B11      1 // main counter
  #define bsPD             1 // Test purpose only, must be set to 0
  #define bscount_B11      0 // main counter
```

```
// REG1
  #define bwcount_B10_3   8 // main counter
  #define bscount_B10_3   0 // main counter
// REG2
  #define bwcount_B2_0    3 // main counter
  #define bwcount_A       5 // swallow counter
  #define bscount_B2_0    5 // main counter
  #define bscount_A       0 // swallow counter
// REG3
  #define bwREF_CLK_DIV_RATIO9_2 8 // Ref clock divider ratio
#define bsREF_CLK_DIV_RATIO9_2 0    // Ref clock divider ratio
// REG4
  #define bwREF_CLK_DIV_RATIO1_0 2 // Ref clock divider ratio
#define bwPLL_A           2 // VCO Amplitude control
  #define bwCPSEL         3 // charge pump output current control
  #define bwPSC_SEL       1 // Prescaler modulus select
  #define bsREF_CLK_DIV_RATIO1_0 6 // Reference clock divider ratio
  #define bsPLL_A         4 // VCO Amplitude control
  #define bsCPSEL         1 // charge pump output current control
  #define bsPSC_SEL       0 // Prescaler modulus select
// REG5
  #define bwINITCAL       1 // Test purpose only,must be set to 0
  #define bwSERCAL        1 // VCO Calibration Enable
  #define bwSELEXTCAL     1 // Test purpose only,must be set to 0
  #define bwCAL           5 // Test purpose only,must be set to 0
  #define bsINITCAL       7 // Test purpose only,must be set to 0
  #define bsSERCAL        6 // VCO Calibration Enable
  #define bsSELEXTCAL     5 // Test purpose only,must be set to 0
  #define bsCAL           0 // Test purpose only,must be set to 0
// REGRO
  #define bwDEV_ID        2 // VCO Calibration Enable
  #define bwLOCK_DET      1 // '1' when PLL is locked
  #define bwINTCAL        5 // Internal value of VCO control word
  #define bsDEV_ID        6 // Dev ID:'00'-> 81101,'01' -> 81102
  #define bsLOCK_DET      5 // '1' when PLL is locked
  #define bsINTCAL        0 // Internal value of VCO control word
// Used for parameters splitted
  #define bwB11           1
  #define bsB11           11
  #define bwB10_3         8
  #define bsB10_3         3
  #define bwB2_0          3
  #define bsB2_0          0
  #define bwREF_DIV9_2    8
  #define bsREF_DIV9_2    2
  #define bwREF_DIV1_0    2
  #define bsREF_DIV1_0    0
#endif //__INTERFACE_I2C
```

```
//*****************************************************************
// -------Public Functions-------
//*****************************************************************
// Global Initialization
t_stw8110x_error STW8110x_Init
(t_stw8110x_Config *Device_config_init
  #ifdef __INTERFACE_I2C
    ,t_uint8 I2C_ADD
  #endif
);
// Configuration
t_stw8110x_error Configure_STW8110x
(t_stw8110x_Config Device_Config
  #ifdef __INTERFACE_I2C
    ,t_uint8 I2C_ADD
  #endif
);
// Getting Information
t_stw8110x_error STW8110x_Get_Fout_value(t_stw8110x_Config
Device_Config, double Fref_clk, double *Fout_MHz);
t_stw8110x_error STW8110x_Check_config(t_stw8110x_Config
Device_Config);

#ifdef __INTERFACE_I2C
  t_stw8110x_error I2C_Read_Status_Register(t_stw8110x_I2C_RO_reg
  *ReadOnlyReg, t_uint8 I2C_ADD);
#endif
// Errors management
void STW8110x_ProcessError(t_stw8110x_error error);
#ifdef __cplusplus
} // allow C++ to use these headers
#endif// __cplusplus
#endif // _STW8110x.H
/**************** End of file - STW8110x.h************************
```

8 Digital_Bus_interface header file

```
/*******************************************************************
     Copyright (C) 2006 STMicroelectronics
     File name:Digital_Bus_interface.h
     Description:Header file for the SPI/I2C Interface Driver code.
       Provides function type and data structure definition
       Creation:11/20/2006
********************************************************************
#ifndef _DBI_H
#define _DBI_H

#ifdef __INTERFACE_I2C
// Type enumeration regarding Acknowledge of I2C mode
   typedef enum
   {
     NO_ACK,
     ACK
   } t_I2C_Ack ;
   // Function dedicated to send data on I2C bus
   // Parameters:
   // data: Table of Bytes to send (in)
   // nb_bytes: number of bytes to send (in)
   // Return:
   // ACK if acknowledge is received by master
   // NO_ACK if acknowledge isn't received by master
   t_I2C_Ack I2C_Send_data(unsigned char *data, int nb_bytes);
   // Function dedicated to read data on I2C bus
   // Parameters:
   // Add: Slave Address to read (in)
   // data: Countain the byte read (out)
   // Return:
   // ACK if acknowledge is received by master
   // NO_ACK if acknowledge isn't received by master
   t_I2C_Ack I2C_Read_data(unsigned char Add, unsigned char *data);
#endif //__INTERFACE_I2C

#ifdef __INTERFACE_SPI
     // Function dedicated to send data on SPI bus
     // Parameters:
     // data: Data (32 bits) to send (in)
     void SPI_Send_data(unsigned int data);
#endif //__INTERFACE_SPI
#endif // _DBI_H
//*********** End of file -Digital_Bus_interface.h*************
```

9 Definitions

Table 4. Acronyms used in this document

Acronym	Definition
API	Application programming interface
HCL	Hardware component layer
WID	Wireless infrastructure division
IC	Integrated circuit
SPI	Serial peripheral interface
I^2C	Inter-integrated circuit
STW8110x	STW81101, STW81102 or STW81103

10 Revision history

Table 5. Document revision history

Date	Revision	Changes
10-Aug-2007	1	Initial release.

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