

Intel® Converged Security and Management Engine Firmware Integrated Clock Controller (ICC) Tool

Tools User Guide

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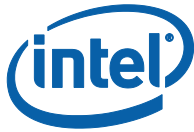
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Revision History

Revision #	Description	Revision Date
0.3	<ul style="list-style-type: none">Initial release.	March 2018
0.5	<ul style="list-style-type: none">Aligning revision number	June 2018
0.51	<ul style="list-style-type: none">Updated Tiger Lake and Intel® CSME references	February 2019
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1.1	<ul style="list-style-type: none">Updated reference documentationAdded Supported Platform for Intel® ICCS APIs	July 2020
1.2	<ul style="list-style-type: none">Added Set Current Clock Settings WrapperEXRemoved WDT section	August 2020
1.3	<ul style="list-style-type: none">Added guidance to build an executable (Chapter 3).	November 2020
1.31	<ul style="list-style-type: none">Updated the IccLibGetMphyVersion APIUpdated format for IccLibGetMphySettingsWrapper API	January 2021
1.32	<ul style="list-style-type: none">Added back Get MPHY Version	February 2021

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1 Introduction

The purpose of the document is to provide guidance on the usage of the tools provided for Intel® Converged Security and Management Engine (Intel® CSME) Firmware Integrated Clock Controller (ICC) included within the Intel firmware kit.

1.1 Terminology

Acronym or Term	Definition
API	Application Programming Interface
BIOS	Basic Input Output System
CPU	Central Processing Unit
DLL	Dynamic Link Library
FW	Firmware
Intel® CSME	Intel® Converged Security and Management Engine
Intel® FIT	Intel® Flash Image Tool
Intel® ICCS	Intel® Integrated Clock Controller Services
Intel® MEI	Intel® Management Engine Interface (formerly HECI)
PCH	Platform Controller Hub
Permanent UOB	UOB that is applied on every boot.
UOB	Update on Boot. A record of ICC registers setting that is applied on the next platform boot.



1.2 Reference Documents

Document	Document No./Location
SPI Programming Guide	Intel® CSME kit on Intel® VIP
Intel® CSME Firmware Bring Up Guide	Intel® CSME kit on Intel® VIP
Tiger Lake UP3/UP4 Platform Controller Hub (PCH) External Design Specification Volume 2 of 2	RDC Reference #:575857

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2 Intel® ICCS SDK

2.1 Intel® ICCS SDK

Intel® Integrated Clock Controller Services (Intel® ICCS) provides a lot of flexibility for OS applications. To ease OS application development and to avoid erratic programming of ICC, Intel provides an ICC Control Library and abstracts ICC hardware from clock tuning applications such as BIOS.

2.2 Intel® ICCS Control Library SDK Features

ICC HW is only accessible to Intel® Management Engine (Intel® ME) and is accessible indirectly to the host software through a set of Intel® Management Engine Interface (Intel® MEI) APIs that are known to the Intel® Integrated Clock Controller Service. Intel does not expose those Intel MEI APIs and does not recommend OS applications to use them to keep platform stability.

Example of application that may call Intel® Integrated Clock Controller Service:

- Intel® Extreme Tuning Utility (Intel® XTU). This application can overclock or underclock platform BCLK (Processor clock).

2.3 Intel® Integrated Clock Controller Service Data Structures

Intel® Integrated Clock Controller Service provides a simplified ICC data structures and APIs for clock manipulation. The new data structure has significantly been reduced and simplified compared to previous generation of ICC control library. The ICC data structure is described in this section.

Note: Intel® ICC SDK is backwards compatible. The table below lists which APIs are supported for TGL and RKL. Some APIs are not supported in TGL and later programs due to Intel® ICC BASE Clock Re-partitioning. Refer to RDC Doc ID [627172](#) for more details.

Table 2. Intel® Integrated Clock Controller Service API Data Structures

Name	Type	Description	Supported Platforms
ICC_HECI_CLOCK_ID	Enum	Defines the clock id for applicable clocks	TGL/RKL
ErrorCodes	UINT32	Returns error codes from Intel® Integrated Clock Controller Service API calls	TGL/RKL
ICC_GET_CLOCK_SETTIN GSEx	Struct	Contains the current clock setting	RKL



Name	Type	Description	Supported Platforms
ICC_SET_CLOCK_SETTINGSEx	Struct	Contains updatable clock setting	RKL
GET_MPHY_VERSION	Struct	Contains the current ChipsetInit version	TGL/RKL
IccLibGetMphyVersion	UINT32	Retrieves the MPHY version	TGL/RKL
ICCLibGetMphySettingsWrapper	Method	Returns MPHY table with current settings	TGL/RKL
ICCLibSetMphySettingsWrapper	Method	Changes MPHY table current settings to the requested value	TGL/RKL

2.3.1 ICC_HECI_CLOCK_ID Type

The ICC_HECI_CLOCK_ID data structure provides the applicable clock to be selected with the following structure.

```
typedef enum
{
    ICC_HECI_PCIE_CLOCK_ID = 0,
    ICC_HECI_BCLK_CLOCK_ID = 1,
    ICC_HECI_WMPHY_CLOCK_ID = 2
}ICC_HECI_CLOCK_ID;
```

Table 3. Intel ICC_HECI_CLOCK_ID type

Name	Description
ICC_HECI_PCIE_CLOCK_ID	PCIe Clock (CPUBCLK Signal to CPU)
ICC_HECI_BCLK_CLOCK_ID	BCLK Clock (CPUBCLK Signal to CPU)
ICC_HECI_WMPHY_CLOCK_ID	White Mountain PLL

2.3.2 ErrorCodes Type

The ErrorCodes data structure provides description of the return error code from the Intel® Integrated Clock Controller Service.

The returned values are represented in UINT32 the following function is required to parse the values into char type:

```
const char* GetErrorStringByCode(const UINT32 errorCode);
```

2.3.3 ICC_GET_CLOCK_SETTINGSEx Type

The ICC_GET_CLOCK_SETTINGSEx structure provides all the clock settings details as the following:

```
typedef struct _ICC_GET_CLOCK_SETTINGSEx
```




```
{
    UINT32 Frequency;
    UINT32 UserFrequency;
    UINT32 MaxFrequency;
    UINT32 MinFrequency;
    UINT8 SscMode;
    UINT8 SscPercent;
    UINT8 MaxSscPercent;
    UINT16 CurrentFlags;
    UINT16 SupportFlags;
} ICC_GET_CLOCK_SETTINGSEx;
```

The returned values are represented in UINT32 the following function is required to retrieve the clock settings :

```
UINT32 IccLibGetCurrentClockSettingsWrapper (const ICC_HECI_CLOCK_ID
clockId, ICC_GET_CLOCK_SETTINGSEx * const clockSettings);
```

2.3.4 ICC_SET_CLOCK_SETTINGSEx Type

The ICC_SET_CLOCK_SETTINGSEx structure provides all the updatable clock settings as the following:

```
typedef struct _ICC_SET_CLOCK_SETTINGSEx
{
    UINT32 UserFrequency;
    UINT8 SscPercent; // encoding example: 1.28% -> SSC_SPREAD value is
128
    BOOL SetToDefault;
    BOOL ForcePowerFlow;
} ICC_SET_CLOCK_SETTINGSEx;
```

The set values are represented in UINT32 the following function is required to configure the clock setting:

```
UINT32 IccLibSetCurrentClockSettingsWrapper(const ICC_HECI_CLOCK_ID
clockId, ICC_SET_CLOCK_SETTINGSEx * clockSettings);
```

2.3.5 GET MPHY Version

The GET_MPHY_VERSION structure provides the MPHY table information as the following:

```
typedef union _GET_MPHY_VERSION
{
    UINT32 data;
    struct
    {
        UINT32 CRC : 16;
    }
};
```



```
    UINT32 Ver : 8;  
    UINT32 Product_and_Stepping : 8;  
} Fields;  
  
} GET_MPHY_VERSION;
```

The returned values are represented in UINT32 the following function is required to retrieve the MPHY version:

```
UINT32 IccLibGetMphyVersion(GET_MPHY_VERSION *survTable)
```

2.3.6 IccLibGetMphyVersion

The IccLibGetMphyVersion returned values are represented in UINT32. The method format is the following:

```
@param[out] version      MPHY table version  
  
@return status  
  
UINT32 IccLibGetMphyVersion(GET_MPHY_VERSION *version)
```

2.3.7 IccLibGetMphySettingsWrapper

The IccLibGetMphySettingsWrapper returned values are represented in UINT32. The method format is the following:

```
@param[in] length        num of bytes to read  
  
@param[in] offset        start offset  
  
@param[out] buffer        current settings of mphy table  
  
@param[out] bytesRead    num of bytes read  
  
@param[out] mphyTotalSize size of MPHY table  
  
@return status  
  
UINT32 IccLibGetMphySettingsWrapper(UINT32 length, UINT32 offset, UINT8  
*buffer,UINT32 *bytesRead, UINT32* mphyTotalSize);
```

2.3.8 IccLibSetMphySettingsWrapper

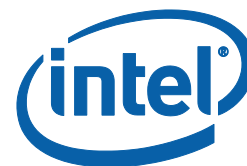
The IccLibSetMphySettingsWrapper changes MPHY table current settings to the requested value,

* leaving all others intact. Error will be returned on range violation.

The method format is the following:



```
@param[in] mphyFileName  the name of the settings file  
@return status  
UINT32 IccLibSetMphySettingsWrapper(char *mphyFileName);
```



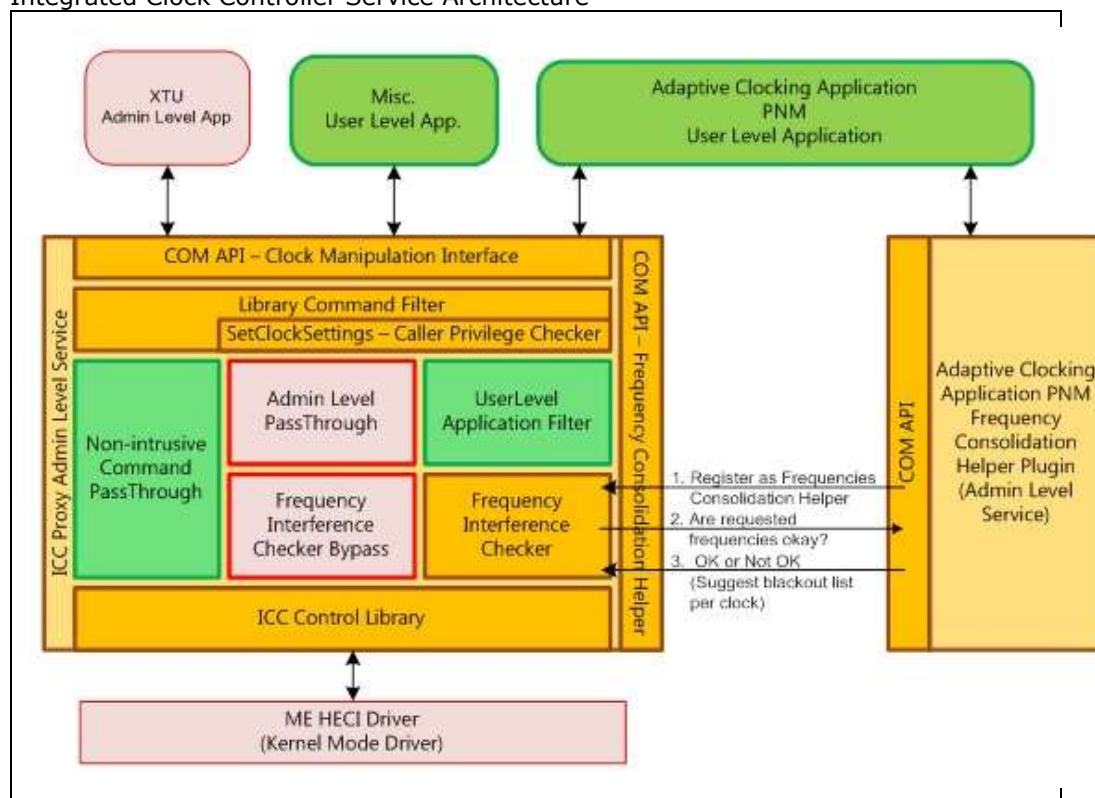
2.4 Intel® Integrated Clock Controller Service API – Clock Manipulation Interface

The Intel® Integrated Clock Controller Service provides a new set of simplified APIs in form of COM. The API exposed by the Intel® Integrated Clock Controller Service is used for communication between Intel® Integrated Clock Controller Service and client applications.

It is assumed that an application would only configure ICC clocks that “belong” to it. There is no provision in the library to lock a specific clock from a specific application.

Each API in the following section provides detail about Input and Output parameters for each API, as well as function prototype. For this guide, example in the following programming language will be provided: IDL and C++. Other programming languages are supported by the API, but an example will not be provided by this SDK user guide.

Note: Please note that Intel MEI Driver installation is required. Figure 1. Intel® Integrated Clock Controller Service Architecture



2.4.1 Get Current Clock Settings Wrapper

Through this function, the host application can get the runtime settings of the ICC clock identified by `ICC_HECI_PCIE_CLOCK_ID` parameter. The request returns the runtime settings of the clock.

**Definition:**

```
UINT32 IccLibGetCurrentClockSettingsWrapper(const ICC_HECI_CLOCK_ID
clockId, ICC_GET_CLOCK_SETTINGSEX * const clockSettings);
```

Table 4. Get Clock Runtime Settings Parameters

Type	Field	Description
Input	clockId	Clock identifier
Output	clockSettings	Runtime settings of the clock. Meaningful only if successful status is received.

2.4.2 Set Current Clock Settings Wrapper

Host application calls this function to change the settings of one of the ICC clocks.

For host application (with Admin level) call, the request will be verified against the ICC Clock Range Definition Record.

For host application (with user level) call, the request will be verified against the ICC enhanced SKU Clock Range definition.

Note: If the requested frequency is not supported by the HW, it will be automatically rounded by Intel® Integrated Clock Controller Service to the nearest valid frequency. If there are two nearest valid frequencies (up and down), the lower value will be chosen.

Definition:

```
UINT32 IccLibSetCurrentClockSettingsWrapper(const ICC_HECI_CLOCK_ID
clockId, ICC_SET_CLOCK_SETTINGSEX * clockSettings);
```

Table 5. Set Clock Runtime Settings Parameters

Type	Field	Description
Input	clockId	Clock identifier
Input	clockSettings	Runtime configuration for the clock.

2.4.3 Set Current Clock Settings WrapperEX

If dynamic tuning is supported, the host can immediately change settings of a given clock to the requested value, leaving all others intact. Error will be returned on range violation.

Definition

```
UINT32 IccLibSetCurrentClockSettingsWrapperEX(const ICC_HECI_CLOCK_ID
clockId, ICC_SET_CLOCK_SETTINGSEX* clockSettings, ICC_SET_CLOCK_SETTING_TYPE
type);
```



Table 6. Set Clock Runtime Settings Parameters

Type	Field	Description
Input	clockId	Clock identifier
Output	clockSettings	Runtime settings of the clock. Meaningful only if successful status is received.

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3 *Building an Executable*

The following are general steps to build an executable file with Intel® ICC SDK files:

1. Create a new Visual Studio* project
2. Copy the following files to the project folder:
 - IccSdk.lib
 - Icc_sdk_api.h
3. Add to icc_sdk_api.h file:

```
#ifndef COMPILE_WITH_ICC_SDK_BINARIES  
  
#define COMPILE_WITH_ICC_SDK_BINARIES  
  
#endif
```
4. Link the library to the exe file:
 - Properties → Linker → Input → Additional Dependencies → Edit
 - ".\..\ADD_PATH_TO_LIB_FOLDER\IccSdk.lib"

