

具UID进阶保护的IO切换范例

NuMicro® 32 位系列微控制器范例代码介绍

文件信息

代码简述	透过判断自定义 UID 决定 IO 是否切换的范例代码
BSP 版本	M051 Series BSP CMSIS v3.01.001
开发平台	NuTiny-EVB-M051_V3.0

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1 功能介绍

1.1 简介

Nuvoton M051 系列微处理器提供UID (Unique Identifier)，开发者在应用上可透过识别UID的正确性，决定应用是否继续执行，确保产品不被任意复制仿冒。单纯的UID识别安全性似乎不足，因此将提供一个可自行增加识别复杂度范例，开发者可以基于微处理器的UID，再进行自定义的运算，使用运算过的UID识别有更佳的安全性。

1.2 原理

为了方便开发可直接将芯片UID读出并加以运算，接着合并应用程序再写入芯片，此范例分为三个区块，请参考图1-1，下列将对每区块做说明：

1. **NuLink.exe** : Nuvoton 提供的简易工具，必须搭配 NuLink ICE 使用，在此使用 NuLink.exe 进行 UID 读取及烧入修改后的应用。
2. **TCDEF.exe** : Visual C++ 所编译，提供将 NuLink 读回的 UID 经自定义运算后，与 Keil 所产生的应用 bin 档做合并。
3. **APROM.bin** : 开发者应用专案，必须包含预留运算后 UID 的区域，及如何识别运算后 UID 的判断程序。

方便操作，关于上述流程，最后会使用批文件将流程整合，若开发者已完成UID自定义运算，及如何识别UID自定义运算后的程序，直接操作批文件即可。

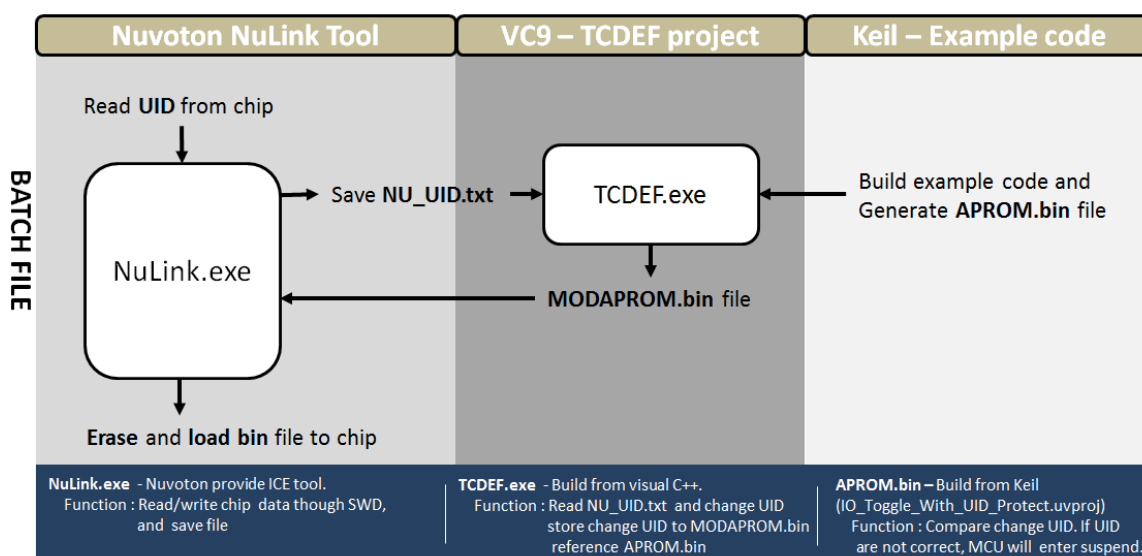


图1-1 范例流程简介

从芯片读出的UID执行完自定义运算后，将存放于APROM保留位置，APROM保留位置在example code 与 TCDEF.exe 定义要相同，如图1-2。

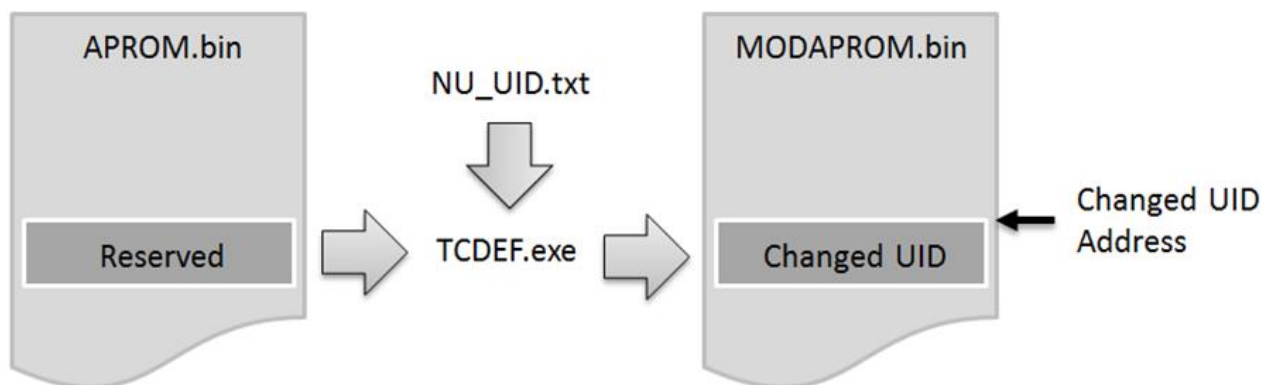


图1-2自定义运算后UID的存放位置

此范例自定义运算的部分预留，提供整个流程方法，最后比较芯片UID及存放于APROM的UID是否相同。

1.3 执行结果

1. 执行 IO_Toggle_With_UID_Protect.bat，显示如下图 1-3 command line 视窗，执行上述所介绍之流程，完成烧入后，按下任意键将结束 command line 视窗，晶片将重新执行自定义 UID 的应用程序。

```

C:\Windows\system32\cmd.exe
C:\Example_Refine\FY_UID\EC_M051_IO_Toggle_With_UID_Protect\SampleCode\ExampleCode\IO_Toggle_With_UID_Protect>del .\Exc\log.txt
C:\Example_Refine\FY_UID\EC_M051_IO_Toggle_With_UID_Protect\SampleCode\ExampleCode\IO_Toggle_With_UID_Protect>del .\Exc\NU_UID.txt
C:\Example_Refine\FY_UID\EC_M051_IO_Toggle_With_UID_Protect\SampleCode\ExampleCode\IO_Toggle_With_UID_Protect>cd NuLink
C:\Example_Refine\FY_UID\EC_M051_IO_Toggle_With_UID_Protect\SampleCode\ExampleCode\IO_Toggle_With_UID_Protect\NuLink>NuLink.exe -r UID 1>.\Exc\NU_UID.txt
C:\Example_Refine\FY_UID\EC_M051_IO_Toggle_With_UID_Protect\SampleCode\ExampleCode\IO_Toggle_With_UID_Protect\NuLink>cd ..
C:\Example_Refine\FY_UID\EC_M051_IO_Toggle_With_UID_Protect\SampleCode\ExampleCode\IO_Toggle_With_UID_Protect>.\Visual_C\Debug\TCDEF.exe
get=144, Start to read UID.
>>> UID: 0x00000005-0x941B8F5E-0x000014C7

***** Execute operation ending *****
UID=0x00000005-0x941B8F5E-0x000014C7

temp2=5,temp=0,temp1=5
temp2=0,temp=0,temp1=0
temp2=0,temp=0,temp1=0
temp2=0,temp=0,temp1=0
temp2=5,temp=5,temp1=5
temp2=8,temp=8,temp1=8
temp2=1b,temp=1,temp1=b
temp2=94,temp=9,temp1=4
temp2=c7,temp=c,temp1=7
temp2=14,temp=1,temp1=4
temp2=0,temp=0,temp1=0
temp2=0,temp=0,temp1=0
printf UID begin!
5 0 0 0-5e8f1b94-c714 0 0
printf UID end!
open APROM.bin OK
filelen=6480
curIndex=8192,sIndex=256
C:\Example_Refine\FY_UID\EC_M051_IO_Toggle_With_UID_Protect\SampleCode\ExampleCode\IO_Toggle_With_UID_Protect>cd NuLink
C:\Example_Refine\FY_UID\EC_M051_IO_Toggle_With_UID_Protect\SampleCode\ExampleCode\IO_Toggle_With_UID_Protect\NuLink>NuLink.exe -e ALL 1>.\Exc\log.txt
C:\Example_Refine\FY_UID\EC_M051_IO_Toggle_With_UID_Protect\SampleCode\ExampleCode\IO_Toggle_With_UID_Protect\NuLink>NuLink.exe -w APROM .\..\Exc\MODAPROM.bin 1>.\Exc\log.txt
C:\Example_Refine\FY_UID\EC_M051_IO_Toggle_With_UID_Protect\SampleCode\ExampleCode\IO_Toggle_With_UID_Protect\NuLink>NuLink.exe -v APROM .\..\Exc\MODAPROM.bin 1>.\Exc\log.txt
C:\Example_Refine\FY_UID\EC_M051_IO_Toggle_With_UID_Protect\SampleCode\ExampleCode\IO_Toggle_With_UID_Protect\NuLink>NuLink.exe -w CFG0 0xffffffff 1>.\Exc\log.txt
C:\Example_Refine\FY_UID\EC_M051_IO_Toggle_With_UID_Protect\SampleCode\ExampleCode\IO_Toggle_With_UID_Protect\NuLink>NuLink.exe -r CFG0 1>.\Exc\log.txt
C:\Example_Refine\FY_UID\EC_M051_IO_Toggle_With_UID_Protect\SampleCode\ExampleCode\IO_Toggle_With_UID_Protect\NuLink>ECHO Press any key will reset mcu.
Press any key will reset mcu.
C:\Example_Refine\FY_UID\EC_M051_IO_Toggle_With_UID_Protect\SampleCode\ExampleCode\IO_Toggle_With_UID_Protect\NuLink>pause
Press any key to continue . . .

```

圖 1-3 批文件執行結果

2. 比对芯片 UID 与 自定义运算后 UID 相同，芯片将持续由 PB13 Toggle。

```

CPU @ 50000000 Hz
Example : IO toggle with UID protect
Unique ID 0 ..... [0x00000005]
Unique ID 1 ..... [0x941b8f5e]
Unique ID 2 ..... [0x000014c7]
Modify ID 0 ..... [0x00000005]
Modify ID 1 ..... [0x941b8f5e]
Modify ID 2 ..... [0x000014c7]
=> Match UID, MCU toggle PB13...

```

图 1-4 由 UART 输出范例执行结果

2 代码介绍

2.1 Batch file - IO_Toggle_With_UID_Protect.bat

删除 log.txt and NU_UID.txt file

```
Del .\Exc\log.txt  
Del .\Exc\NU_UID.txt
```

读取芯片 UID 并储存于 NU_UID.txt file

```
NuLink.exe -r UID >> .\..\Exc\NU_UID.txt
```

执行 TCDEF.exe

```
.\Visual_C\Debug\TCDEF.exe
```

抹除芯片

```
NuLink.exe -e ALL >> .\..\Exc\log.txt
```

写入 MODAPROM.bin 并验证

```
NuLink.exe -w APROM .\..\Exc\MODAPROM.bin >> .\..\Exc\log.txt  
NuLink.exe -v APROM .\..\Exc\MODAPROM.bin >> .\..\Exc\log.txt
```

写入 Config0 并读出存于 log.txt

```
NuLink.exe -w CFG0 0xFFFFFFFF >> .\..\Exc\log.txt  
NuLink.exe -r CFG0 >> .\..\Exc\log.txt
```

芯片重新执行

```
NuLink.exe -reset
```

2.2 TCDEF.exe

自定义UID存放开始位置及位移

```
#define APROMUIDADD 0x2000 //Store UID change data start address of APROM  
#define UIDOFFSET 0x100 //Store UID change data offset of APROM
```

开发者自定义UID运算编辑函式

```
void changUIDData()  
{  
    int i = 0;  
    for (i = 0; i < 12; i++);  
    /***** User change UID implement *****/  
}
```

2.3 KEIL – Example code

自定义UID存放位置保留及定义，必须与TCDEF.exe 定义相同

```
#define UID_START_ADDR      0x00002000    // UID start address of APROM
#define UID_ADDR_OFFSET    0x100         // UID address offset of APROM

__attribute__((at(UID_START_ADDR + UID_ADDR_OFFSET))) static const uint32_t
gau32UIDAddr[4]= {2,2,2};
```

判断芯片UID是否与自定义运算后的UID相同，若有自定义运算，需自行加入如何判读自定义UID。

```
/****** User change UID compare implement *****/
/* Compare original UID and change UID */
if((au32mcuUID[0] == au32modfiyUID[0]) && (au32mcuUID[1] == au32modfiyUID[1]) &&
    (au32mcuUID[2] == au32modfiyUID[2]))
{
    printf("=> Match UID, MCU toggle PB13...\n");
    while(1)
    {
        Delay_count(500);
        P35 = 0;
        Delay_count(500);
        P35 = 1;
    }
}
```

3 软件与硬件环境

- 软件环境












- BSP 版本
 - ◆ M051 Series BSP CMSIS v3.01.001
- IDE 版本
 - ◆ Keil uVersion 5.24
- Visual C++ 版本
 - ◆ Microsoft Visual C++ 2008
- NuLink.exe 版本
 - ◆ Nuvoton NuLink Command Tool v2.06.6871

- 硬件环境

- 电路组件
 - ◆ NuTiny-EVB-M051_V3.0

4 目录信息

EC_M051_IO_Toggle_With_UID_Protect

 Library	Sample code header and source files
 CMSIS	Cortex® Microcontroller Software Interface Standard (CMSIS) by Arm® Corp.
 Device	CMSIS compliant device header file
 StdDriver	All peripheral driver header and source files
 SampleCode	
 ExampleCode	Source file of example code
 IO_Toggle_With_UID_Protect	
 KEIL	Example files of KEIL project.
 Exc	Temporary and log files.
 NuLink	Nuvoton NuLink tools.
 Visual_C	Visual C++ project for UID changed.

5 如何执行范例程序

1. 根据目录信息章节进入 ExampleCode 路径中的 KEIL 文件夹，双击 IO_Toggle_With_UID_Protect.uvproj。
2. 进入编译模式接口
 - a. 编译
3. 执行 IO_Toggle_With_UID_Protect.bat
 - a. 确认芯片及 NuLink 已正确连接至 PC.
 - b. 执行 UID 运算及烧入程序
 - c. 重新执行芯片程序

6 修订纪录

Date	Revision	Description
Jul. 9, 2019	1.00	1. 初始发布.

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