MQX Board Support Package Porting Guide on KEIL

by: Guo Jia

Contents

1   Introduction

This application note is a supplement to AN4287: MQX Board Support Package Porting Guide, available on **freescale.com**. AN4287 introduced how to create new BSP in CW7.2, CW10 and IAR, but didn't cover KEIL embedded development products. So, this application note introduces how to create a new BSP in KEIL for porting. In addition, this document also introduces a script tool to help make this procedure much easier. All the discussion in this application note is based on Freescale MQX™ RTOS 3.8.0.

2   Introduction to MQX's BSP

BSP masks the hardware details and provides the uniform interface to the operating system (OS). Before beginning to port a BSP for MQX, it must be known how MQX is organized and how it works.

Figure 1 shows the folder organization of MQX. The folders enclosed by red rectangular boxes (as shown in Figure 1) are significant while porting a BSP. The contents of these folders are described briefly as follows.
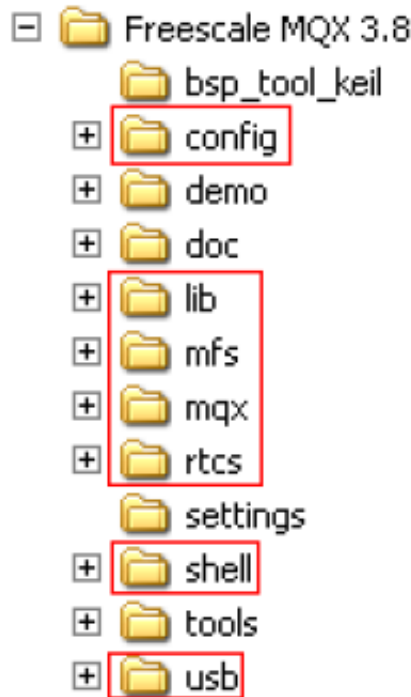
Figure 1. Folder organization of MQX

- **config**: There are two files in this folder:
    - **user_config.h**: The OS feature can be configured by editing this file.
    - **build_libs.uvmpw** at <mqx_install>\config\twrk60n512\uv4: This is a workspace build file which includes all the components of MQX including BSP, PSP, MFS, RTCS. SHELL, and USB. See Figure 2. This workspace must be opened to rebuild the components during the development.
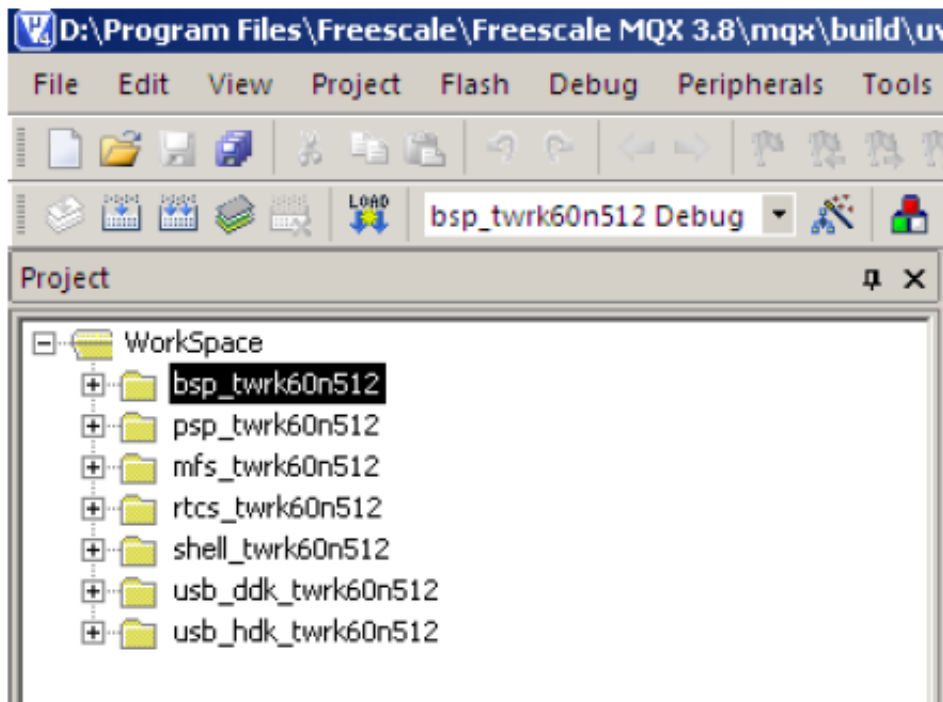

Figure 2. Workspace in <config> folder containing all the MQX components

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- **lib**: This is the output folder for all the projects in Figure 2. It contains the output .lib file and .h file which are used by the application projects. See Figure 3.
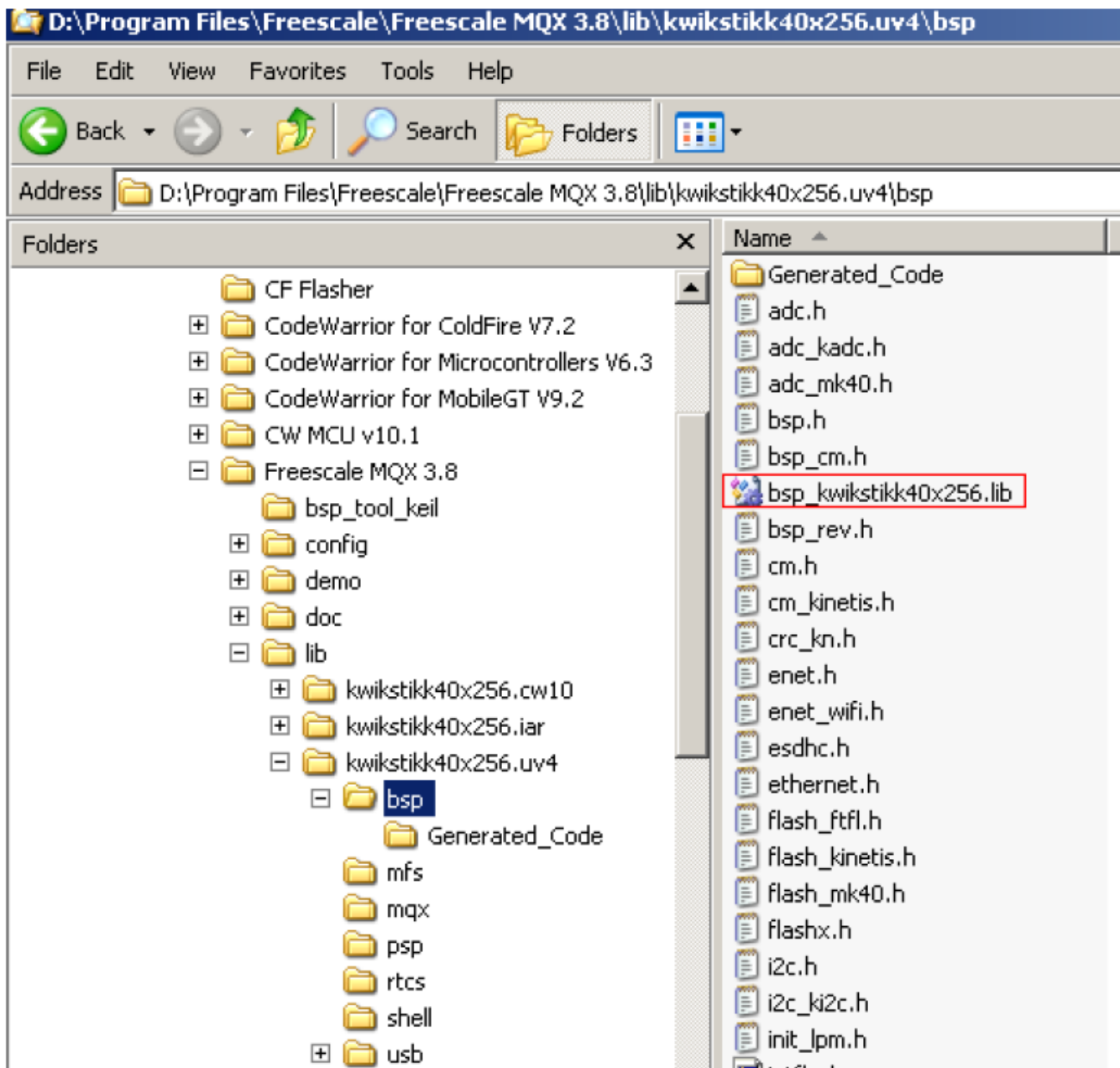

Figure 3. Output folder of lib

- **mqx**: In this folder, there are three important subfolders. See Figure 4.
    - The <mqx\build\bat> folder contains the .bat files which copy the .lib file and .h to the output folder <lib\board_name> after building.
    - The <mqx\build\uv4> folder contains the BSP and PSP project file.
    - The <mqx\source\bsp\board_name> contains the BSP driver source code. This is a very significant folder as the code for the new target board often needs to be modified.
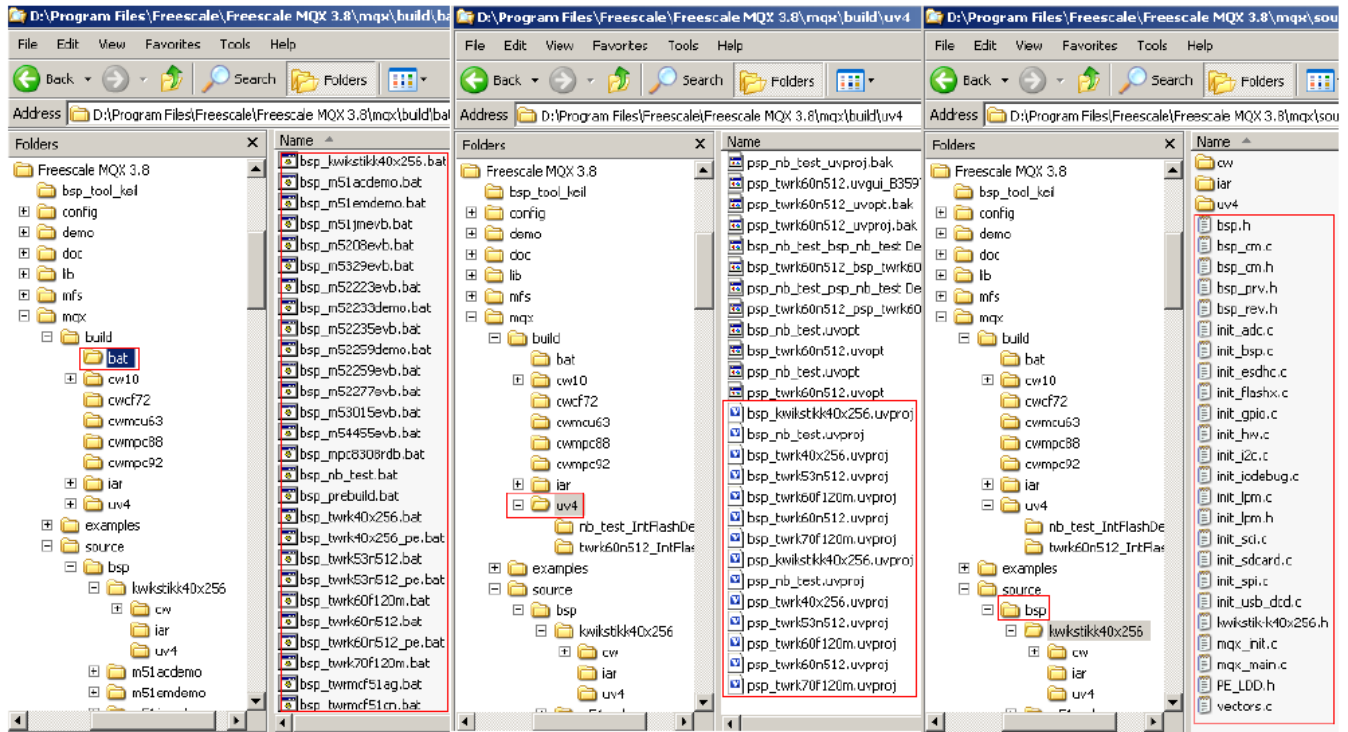
Figure 4. mqx folder and its subfolders

Another mechanism that MQX works in is to execute a .bat file after building. Figure 5 shows how the project specifies the .bat file to be executed after building.
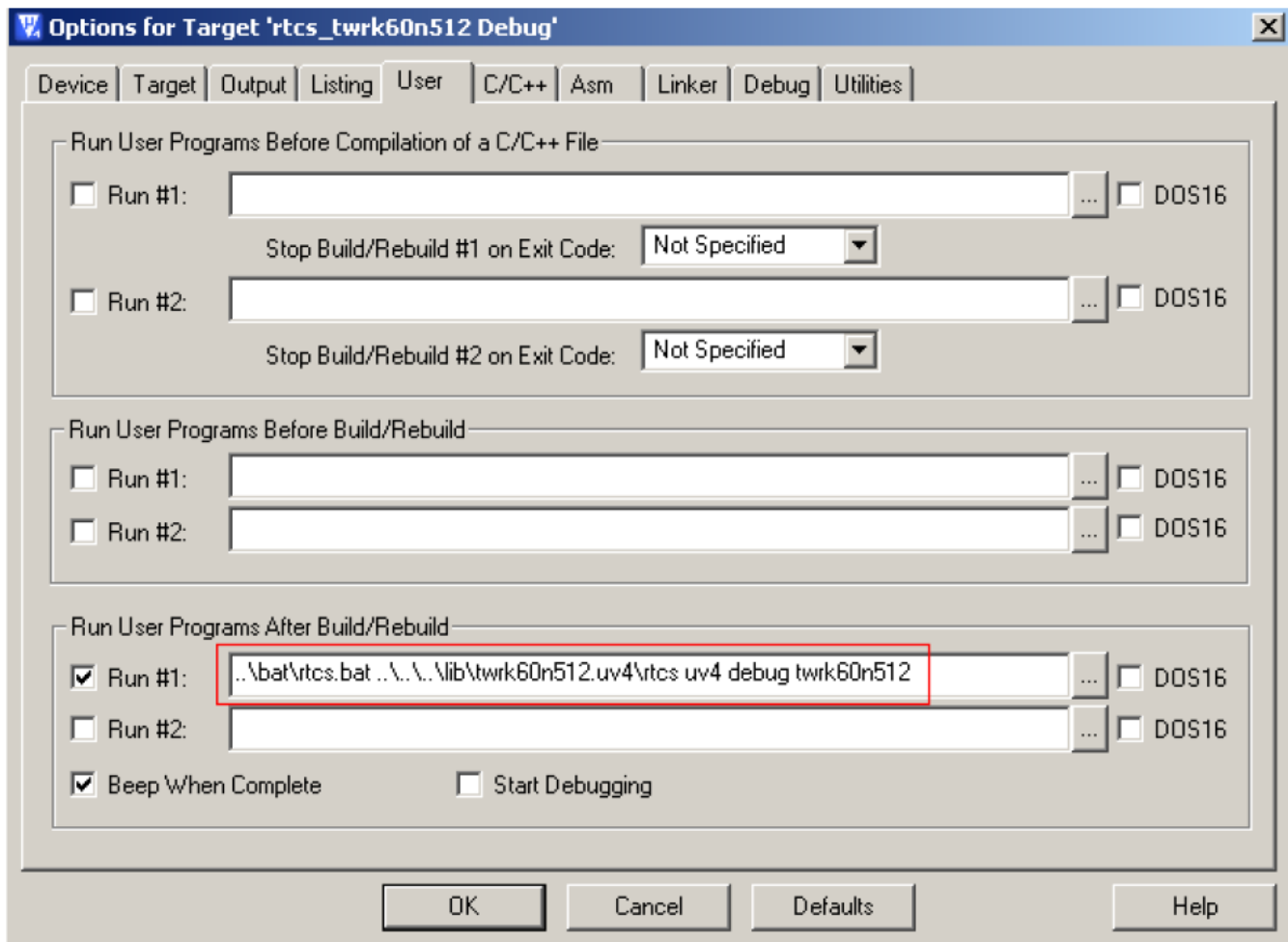
Figure 5. Specify the .bat file to be executed after building

- **mfs, rtcs, shell and usb**: These folders have the project file for corresponding functions. See Figure 6. The user needs to rebuild these projects for the application projects.
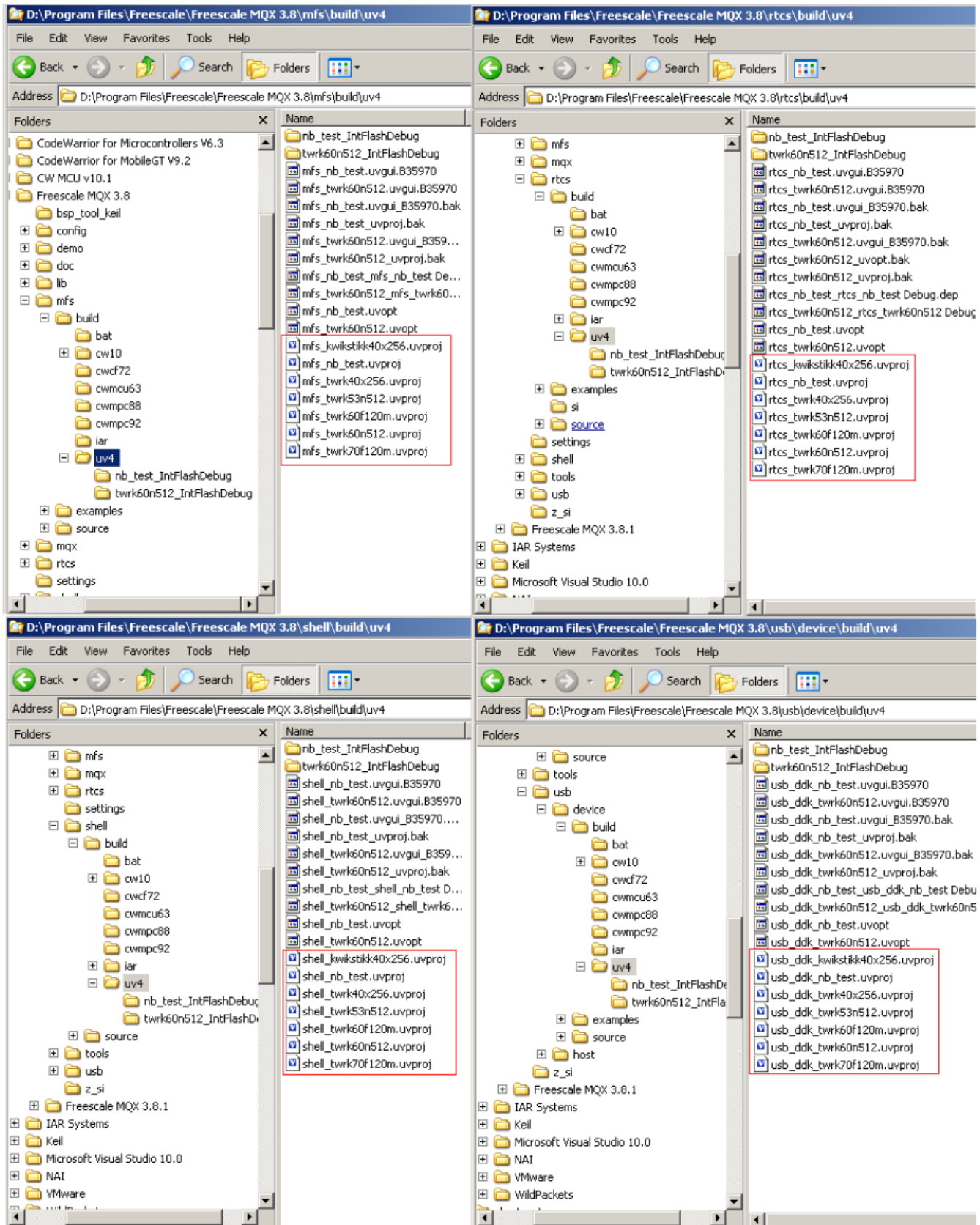
Figure 6. mfs, rtcs, shell and usb folders

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3 Steps to make a new BSP based on an existing BSP manually

This section shows how to make a new BSP from a base BSP, manually. Here is a demo for creating a new BSP named **nb_test** based on the **twrk60n512** BSP. Nb in **nb_test** means 'new board'. This procedure is much similar to the steps introduced in AN4287 with CW and IAR.

This section describes the necessary steps to make a new BSP based on an existing BSP for KEIL. These steps are not a must since a script tool serving the same purpose is provided in Using script tool to accelerate the process. With that script tool, the users just need to type a command to create a new BSP from a base BSP for KEIL. It is strongly suggested to use the method introduced in Using script tool to accelerate the process.

1. Create the output folders at <mqx_install >\lib. See Figure 7. Create the folder nb_test.uv4 and its subfolders, including bsp, psp, mqx, mfs, rtcs, shell, usb, usb/device, usb/host. For MQX 3.8, the output folder mqx is not necessary.
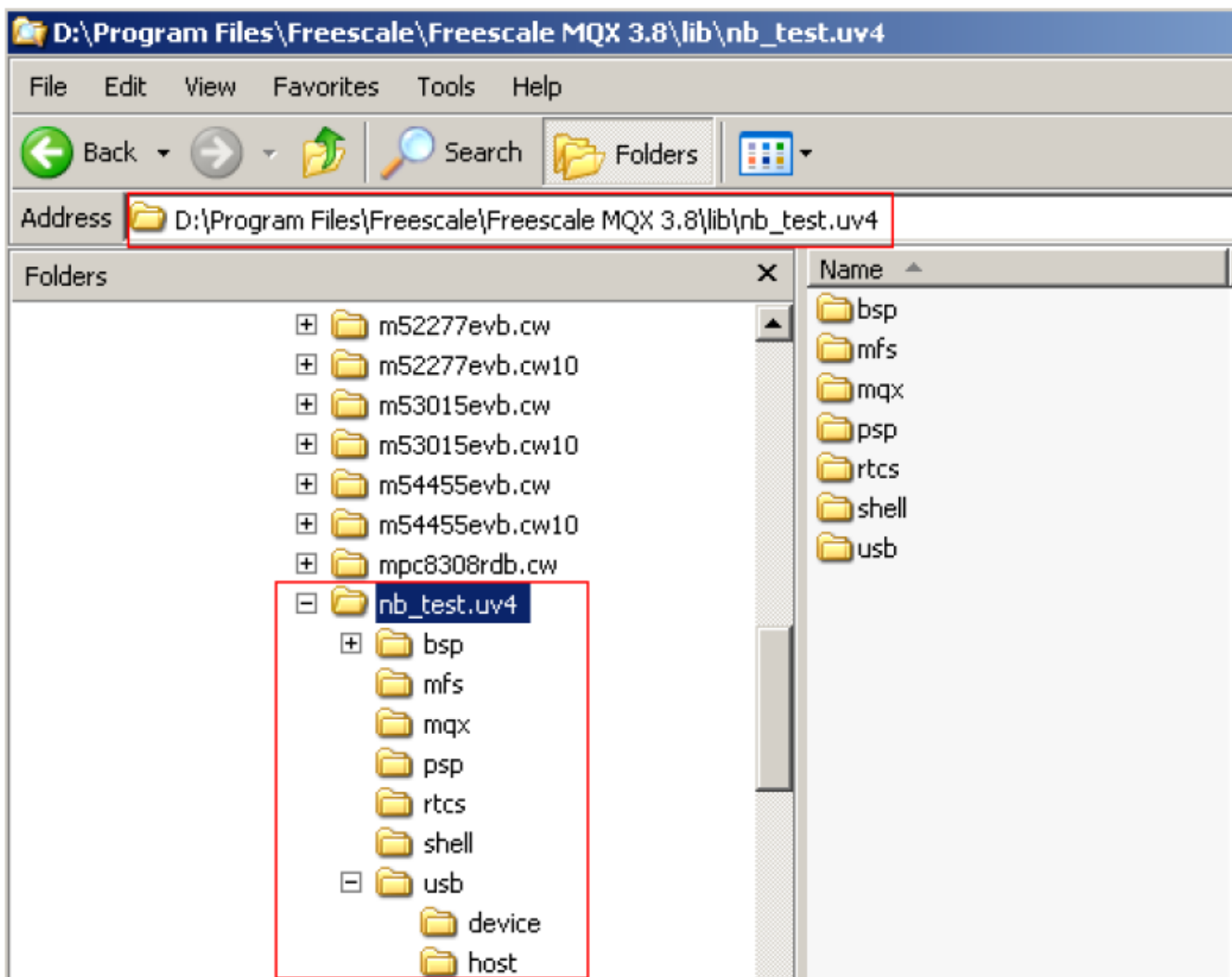

Figure 7. Create output folder at \lib

2. Create folder <mqx_install>\config\nb_test\ and copy all the files at <mqx_install>\config\ twrk60n512\ to it. At <mqx_install> \config\nb_test \uv4\, open build_libs.uvmpw, and replace all **twrk60n512** to **nb_test** in the text.

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3. Make new .bat file at <mqx_install>\mqx\build\bat\ based on bsp_ twrk60n512.bat by copying, pasting, and renaming to bsp_nb_test.bat. Then open bsp_nb_test.bat , and replace all **twrk60n512** to **nb_test** in the text.
4. Make new .bat file at <mqx_install>\mqx\build\bat\ based on psp_ twrk60n512.bat by copying, pasting, and renaming to psp_nb_test.bat. Then open psp_nb_test.bat , and replace all **twrk60n512** to **nb_test** in the text.
5. At <mqx_install>\mqx\build\uv4, copy, paste, and rename bsp_twrk60n512.uvproj to bsp_nb_test.uvproj. Then, open bsp_nb_test.uvproj, and replace all **twrk60n512** to **nb_test** in the text.
6. At <mqx_install>\mqx\build\uv4, copy, paste, and rename psp_twrk60n512.uvproj to psp_nb_test.uvproj. Then open psp_nb_test.uvproj, and replace all **twrk60n512** to **nb_test** in the text.
7. Make a new folder <mqx_install>\mqx\source\bsp\nb_test\, and copy all the files in <mqx_install>\mqx\source\bsp\twrk60n512\ to it.
8. At <mqx_install>\mfs\build\uv4\, copy, paste, and rename mfs_twrk60n512.uvproj to mfs_nb_test.uvproj. Then, open mfs_nb_test.uvproj, and replace all **twrk60n512** to **nb_test** in the text.
9. At <mqx_install>\rtcs\build\uv4\, copy, paste, and rename rtcs_twrk60n512.uvproj to rtcs_nb_test.uvproj. Then, open rtcs_nb_test.uvproj, and replace all **twrk60n512** to **nb_test** in the text.
10. At <mqx_install>\shell\build\uv4\, copy, paste, and rename shell_twrk60n512.uvproj to shell_nb_test.uvproj. Then, open shell_nb_test.uvproj, and replace all **twrk60n512** to **nb_test** in the text.
11. At <mqx_install>\usb\device\build\uv4\, copy, paste, and rename usb_ddk_twrk60n512.uvproj to usb_ddk_nb_test.uvproj. Then, open usb_ddk_nb_test.uvproj, and replace all **twrk60n512** to **nb_test** in the text.
12. At <mqx_install>\usb\host\build\uv4\, copy, paste, and rename usb_hdk_twrk60n512.uvproj to usb_hdk_nb_test.uvproj. Then, open usb_hdk_nb_test.uvproj, and replace all **twrk60n512** to **nb_test** in the text.

4 Using script tool to accelerate the process

4.1 About the script tool

Introduction to MQX's BSP discussed the steps through which the user can make a new BSP. But that procedure is not so easy. So this section discusses how a script tool can make this process easier.

The steps for creating a new BSP given in Introduction to MQX's BSP require a lot of command of creating a new folder, copying a folder and its subfolders and files to other location, renaming a folder or a file, and replacing some text in some files. These operations can be done by executing shell command in script except the command of replacing strings in some files.

The GNU Stream Editor (sed) can be used to implement the text replacement in files. For more information about sed, visit:
- **gnu.org/software/sed/**
- **grymoire.com/Unix/Sed**
- **gnuwin32.sourceforge.net/packages/sed**.

The software attachment AN4626SW.zip associated with this application note has a sed.exe file for Windows and it is tested on Windows XP. The sed command is quite powerful for text replacement. The users can also modify the .bat file provided in the attached software files for other special applications.

The sed commands used here are:
- `sed s/old string/new string/g original file > new file`: This command replaces the old string with the new string and saves the file to a new file with the result of replacing operation.
- `sed s/old string1/new string1/g; s/old string2/new string2/g original file > new file`: This command replaces two strings in the original file to get a new file.

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4.2 Command for making a new BSP

To create a new BSP named nb_test based on the original BSP named twrk60n512, use the following command:

```
bsp_tool_keil create twrk60n512 nb_test
```

Executing this command will result in the new desired BSP. This is quite easier as compared to the steps introduced in Introduction to MQX's BSP.

4.3 Command for deleting a BSP

To delete a new BSP named nb_test , use the following command:

```
bsp_tool_keil  del  nb_test
```

4.4 Command for making a new application project

Similarly, if the user wants to make a new application project to use the BSP just created, operations like copying, pasting, and replacing strings in files, can be executed through commands of this script tool.

To create a new application project to use the special BSP which is just created, use the following command:

```
bsp_tool_keil  sample  twrk60n512  nb_test prj_test
```

This command creates a new sample project named prj_test which uses the BSP named twrk60n512 at the folder: <mqx_install>\mqx\app_project. See Figure 8.
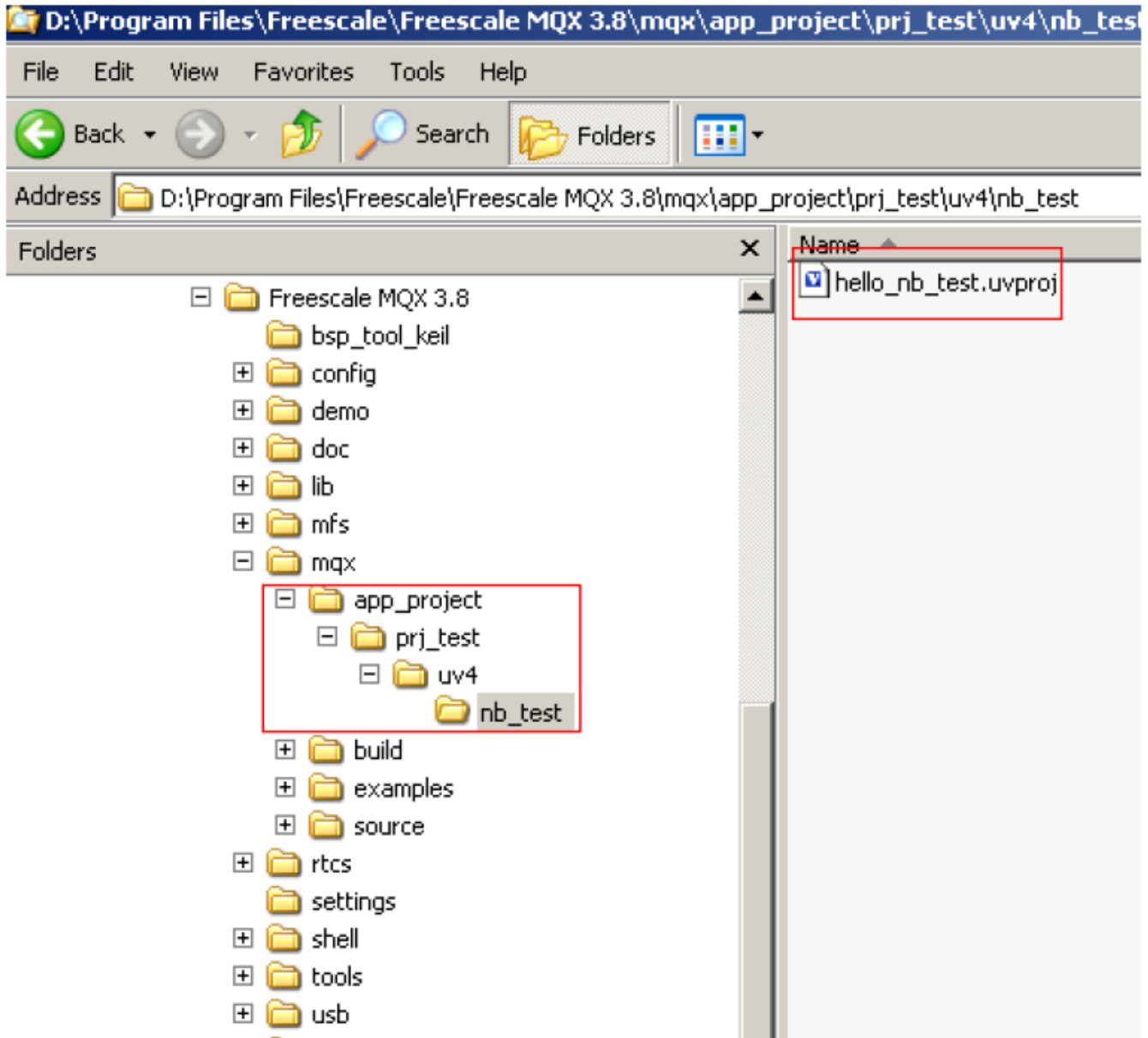
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Figure 8. Making a new application project

4.5   Command for backing up a BSP

It is often needed to backup and restore a BSP during the application development. For example, it may be required to share a BSP to other workmate on different computers, to restore a BSP that is finished a long time ago.

To backup a BSP to the folder D:\mqx_backup, the command is:

```
bsp_tool_keil backup twrk60n512 D:\mqx_backup
```

This command will back up the BSP named twrk60n512 to the folder D:\mqx_backup. Any other folder can also be used as the backup folder.

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4.6   Command for installing a BSP

To install a BSP from D:\mqx_backup, use the following command:

```
bsp_tool_keil install twrk60n512 D:\mqx_backup
```

This command installs the BSP named twrk60n512 to system from the folder D:\mqx_backup.

4.7   Preparation for using the command

1. Before using the commands, make a folder named bsp_tool_keil at <mqx_install>\, uncompress the software attachment of this application note, and copy the files to <mqx_install>\bsp_tool_keil. See Figure 9.
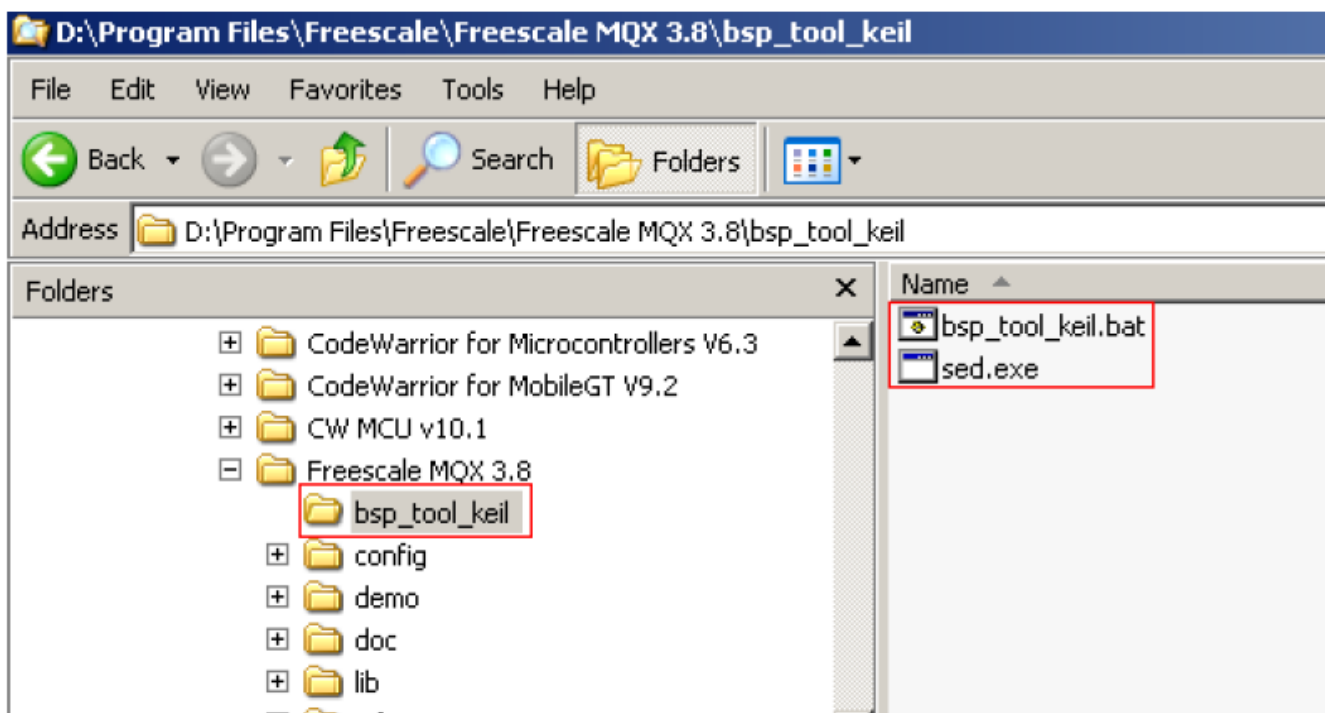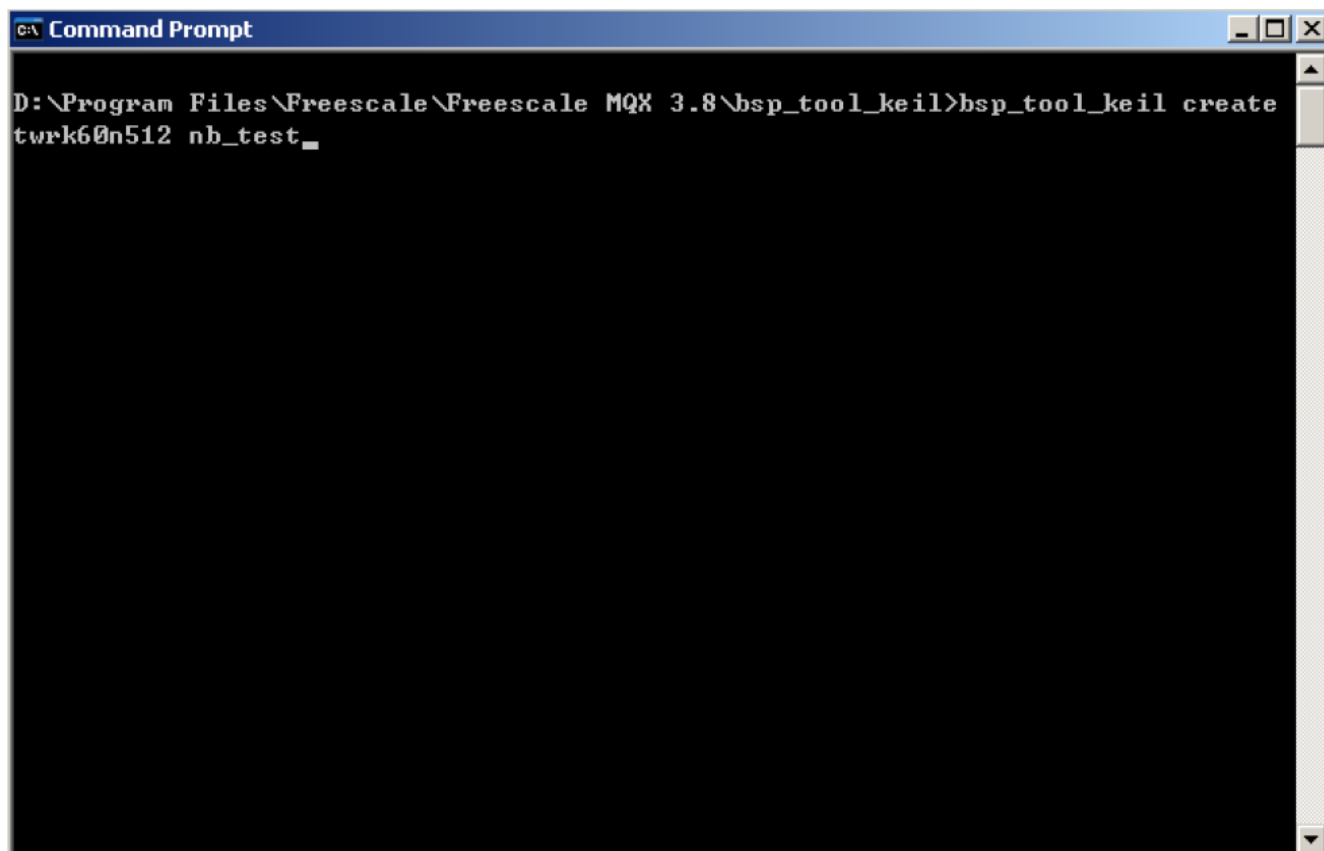

Figure 9. Copy the uncompressed files

2. Then, in the command window, change current folder to D:\Program Files\Freescale\Freescale MQX 3.8\bsp_tool_keil. Now, type the command, as shown in the following figure.

Possible disadvantage of the script tool

Figure 10. Execute the commands

5 Possible disadvantage of the script tool

This tool is not perfect and has some disadvantages as discussed in the following subsections. But, on the whole, this tool still help a lot while creating a new BSP.

5.1 Deletion error (Deleting files or folders erroneously)

As the script tool uses some string matching in the command of deleting a file or folder so, it is possible to erroneously delete some files or folders which are actually significant for the application. To overcome this disadvantage, it is suggested to start the name of new BSP with special letters. It is recommended to use **nb** which means **new board**. This would prevent erroneous deletion of some significant files or folders.

NOTE

The user may use any other word instead of nb to start with as to prevent deletion errors, but before using, make sure it works.

For example, to create a BSP named **my_board_bsp**, rename it to **nb_my_board_bsp**.

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NOTE

The user may use any other word instead of nb to start with as to prevent deletion errors, but before using, make sure it works.

For example, to create a BSP named **my_board_bsp**, rename it to **nb_my_board_bsp**.

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5.2   Replacement error

During the string replacement, the tool can not make out if the current string should be replaced and it just replaces all strings that meet the condition. In some rare cases, this replacement may cause errors which need to be corrected manually. According to the test conducted, replacement errors never occur while creating a BSP based on a K60 tower board. For K40 tower board, replacement error occurs due to some BSP files, such as <mqx_install>\mqx\source\io\lcd\lcd_twrk40x256.c, which are named with the name of BSP as a part.

Two steps are necessary to correct the replacement errors.

1. Compiling error: lcd_nb_k40_001.c: The following error message is shown:

   "Error: #5: cannot open source input file "..\..\..\mqx\source\io\lcd\lcd_nb_k40_001.c": No such file or directory".

   This is caused by the replacement error in in bsp_nb_k40_001.uvproj. To correct it, open <mqx_install>\ mqx\build \uv4\ bsp_nb_k40_001.uvproj and replace the strings of lcd_nb_k40 with green background and red box to lcd_twrk40x256 (see Figure 11).

NOTE
Do not open the project during the replacement.

```
951          <Group>
952            <GroupName>Peripheral IO Drivers:lcd</GroupName>
953            <Files>
954              <File>
955                <FileName>lcd_nb_k40_001.c</FileName>
956                <FileType>1</FileType>
957                <FilePath>..\..\..\mqx\source\io\lcd\lcd_nb_k40_001.c</FilePath>
958              </File>
959              <File>
960                <FileName>lcd_nb_k40_001.h</FileName>
961                <FileType>5</FileType>
962                <FilePath>..\..\..\mqx\source\io\lcd\lcd_nb_k40_001.h</FilePath>
963              </File>
964              <File>
965                <FileName>lcd_nb_k40_001_prv.h</FileName>
966                <FileType>5</FileType>
967                <FilePath>..\..\..\mqx\source\io\lcd\lcd_nb_k40_001_prv.h</FilePath>
968              </File>
969            </Files>
970          </Group>
```

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```
2350            <Group>
2351              <GroupName>Peripheral IO Drivers:lcd</GroupName>
2352              <Files>
2353                <File>
2354                  <FileName>lcd_nb_k40_001.c</FileName>
2355                  <FileType>1</FileType>
2356                  <FilePath>..\..\..\mqx\source\io\lcd\lcd_nb_k40_001.c</FilePath>
2357                </File>
2358                <File>
2359                  <FileName>lcd_nb_k40_001.h</FileName>
2360                  <FileType>5</FileType>
2361                  <FilePath>..\..\..\mqx\source\io\lcd\lcd_nb_k40_001.h</FilePath>
2362                </File>
2363                <File>
2364                  <FileName>lcd_nb_k40_001_prv.h</FileName>
2365                  <FileType>5</FileType>
2366                  <FilePath>..\..\..\mqx\source\io\lcd\lcd_nb_k40_001_prv.h</FilePath>
2367                </File>
2368              </Files>
2369            </Group>
```

Figure 11. Replacement error in bsp_nb_k40_001.uvproj

2. Then, the following compiler error occurs while compiling the application project.

   "Error: #5: cannot open source input file "lcd_twrk40x256.h": No such file or directory".

   This is caused by the replacement error in bsp_nb_k40_001.bat. See Figure 12. To correct it, replace lcd_nb_k40_001.h with lcd_twrk40x256.h and rebuild BSP.

```
     bsp_nb_k40_001.uvproj    bsp_nb_k40_001.bat
76  copy /Y ..\..\..\mqx\source\io\sdcard\sdcard_spi\sdcard_spi.h .
77  copy /Y ..\..\..\mqx\source\io\sdcard\sdcard_esdhc\sdcard_esdhc.h .
78  copy /Y ..\..\..\mqx\source\io\enet\ethernet.h .
79  copy /Y ..\..\..\mqx\source\io\enet\enet.h .
80  copy /Y ..\..\..\mqx\source\io\enet\enet_wifi.h .
81  copy /Y ..\..\..\mqx\source\io\lcd\lcd_nb_k40_001.h .
82  copy /Y ..\..\..\mqx\source\io\tchres\tchres.h .
83  copy /Y ..\..\..\mqx\source\io\lpm\lpm.h .
84  copy /Y ..\..\..\mqx\source\io\lpm\lpm_kinetis.h .
85  copy /Y ..\..\..\mqx\source\io\cm\cm.h .
86  copy /Y ..\..\..\mqx\source\io\cm\cm_kinetis.h .
87  copy /Y ..\..\..\mqx\source\io\debug\iodebug.h .
```

Figure 12. Replacement error in bsp_nb_k40_001.bat

Therefore, it can be easily seen that even in this situation, the tool still enhances the speed to create a new BSP.

6 Conclusion

This application note discussed steps to port MQX BSP for KEIL. To start with, an introduction to the MQX organization and how the BSP works, is given. After that, steps to create a new BSP manually, are provided. Then, it is shown how a script tool can be used to accelerate the procedure of creating a new BSP. The last section of this document covers some possible disadvantages of this tool and recommended ways to overcome them.

7 References

The following reference documents are available on **freescale.com**

- AN4287: MQX Board Support Package Porting Guide
- FSL_MQX_PORTING_GUIDE : Porting Guide Freescale MQX™ RTOS