Introduction

The eTPU assembly converter is a tool used to convert Byte Craft eTPU assembly code for SPC563Mxx and SPC564Axx devices to eTPU compiler assembly code. The tool can be used either to convert specific instructions manually or to convert entire .asm files, .c files or directories. The tool only converts assembly instructions (either in .asm files or in inline assembly sections in c files). With this tool it is possible to easily convert files which were previously compiled in Byte Craft to the new compiler for eTPU.
Contents

1 Command line options .............................................. 4

2 Convert mode .......................................................... 5
   2.1 Convert mode-language ........................................... 5
      2.1.1 Assembly mode .............................................. 5
      2.1.2 C mode ...................................................... 5
   2.2 Convert mode-input type ........................................ 5
      2.2.1 Manual mode ............................................... 5
      2.2.2 Directory/file mode ...................................... 5
   2.3 Examples ......................................................... 6
      2.3.1 Manual assembly mode .................................... 6
      2.3.2 Manual C mode ............................................ 6
      2.3.3 File assembly mode ....................................... 6
      2.3.4 File C mode ............................................... 7

3 Converter options ..................................................... 8
   3.1 No warnings ..................................................... 8
   3.2 Preprocessing .................................................. 8
   3.3 Debug information ............................................. 8

4 Converter operation ................................................ 9
   4.1 Context ......................................................... 9
   4.2 Error handling ................................................ 9
   4.3 Variables ..................................................... 9
   4.4 Parallel instructions ......................................... 9

5 Limitations ............................................................ 10
   5.1 Complex expressions ......................................... 10
   5.2 Negative numbers ............................................ 10
   5.3 Macros ......................................................... 10
   5.4 Byte Craft errors ............................................ 10
   5.5 Unsupported features ....................................... 10
   5.6 Parallel instructions ......................................... 11
5.7 Warnings ...................................................... 11
  5.7.1 ld/ldm .................................................. 11
  5.7.2 Hex directives ........................................ 11

6 Revision history ............................................ 12
# Command line options

The following usage appears when running the converter with the `-h` switch. A detailed explanation appears in the sub sections below.

```
etpu_asm_converter [-options] (-c <file> | -a <file> | -m | -mc)
```

Convert modes (exactly one of the following flags must appear):
- `-m`: manual mode, converts assembly instructions from stdin.
- `-mc`: manual mode, converts c text from stdin.
- `-c <c_file> [out_file]`: converts all assembly code in `<c_file>`.

Options (if used, must appear before convert mode):
- `-nowarn`: suppress warnings
- `-h`: display usage message
- `-pp`: preprocess. Replaces macros in assembly sections before converting.
- `-debugE`: debug errors. When this option is used more information is printed if errors occur (please note this option was created for developing purposes, the information refers to lex token names and isn't always helpful).
2 Convert mode

The converter can run either in manual mode (\texttt{-m}, \texttt{-mc}), or in directory/file mode (\texttt{-c}, \texttt{-a}). In both modes, the converter can run in assembly mode (\texttt{-a}, \texttt{-m}) or c mode (\texttt{-c}, \texttt{-mc}).

2.1 Convert mode-language

2.1.1 Assembly mode

In assembly mode (\texttt{-a}, \texttt{-m}) the entire file (or manually inserted input) will be treated as Byte Craft assembly and converted immediately.

2.1.2 C mode

In c mode (\texttt{-c}, \texttt{-mc}) the entire file (or manually inserted input) will be treated as a c language file. The file will be copied line by line and only the inline assembly instructions will be converted. Inline assembly instructions in Byte Craft begin with the \texttt{#asm} directive and end with \texttt{#endasm} directive. One line inline assembly instructions in Byte Craft can also begin with the \texttt{#asm} directive and an open parenthesis and end with a closing parenthesis.

2.2 Convert mode-input type

2.2.1 Manual mode

In manual mode (\texttt{-m}, \texttt{-mc}) the user inserts text manually to the standard input and the converter prints the converted text to the standard output. This mode is useful in order to check specific instructions. Notice that the output is usually printed only after a full instruction has been analyzed (including the ending \texttt{'} character which is essential in Byte Craft).

2.2.2 Directory/file mode

When the converter runs in directory/file mode (\texttt{-a}, \texttt{-c}) a specific file or directory must be specified right after the \texttt{-c} or \texttt{-a} mode switch.

If the argument after the mode switch is a directory, the converter converts all the files in the specified directory which end with the \texttt{.c} extension (if the switch was \texttt{-c}) or the \texttt{.asm} extension (if the switch was \texttt{-a}). Each generated file will be named \texttt{<file_name>.converted.c} or \texttt{<file_name>.converted.asm} depending on the current language mode.

If the argument after the mode switch is a file (and not a directory) the specified file will be converted. In this case another argument may appear right after the file name to specify the name of the new generated converted file. If such an argument does not appear the new file will be called \texttt{<file_name>.converted.c} or \texttt{<file_name>.converted.asm} depending on the working language mode.
2.3 Examples

2.3.1 Manual assembly mode

etpu_asm_converter.exe -m

->alu c=b+a.
add c, b, a
->ram p = by_diob.
ld p, *diob

2.3.2 Manual C mode

etpu_asm_converter.exe -mc

->/* All c information is copied line by line */
/* All c information is copied line by line */
->#asm (alu c=c+1.)
asm{ addi c, c, 1 }
->callExampleCFunc();
callExampleCFunc();
->#asm
asm{
->ram p = (diob++).
ld p, *diob++
->alu c=b.
move c, b
->#endasm
}
->callExampleCFunc();
callExampleCFunc();

2.3.3 File assembly mode

etpu_asm_converter.exe -a asm_input.txt

Table 1. File assemble mode

<table>
<thead>
<tr>
<th></th>
<th>asm_input.txt:</th>
<th>asm_input.txt.converted.asm:</th>
</tr>
</thead>
<tbody>
<tr>
<td>chan write_mera; ram p -&gt; (diob).</td>
<td>erw1: st p,*diob</td>
<td></td>
</tr>
<tr>
<td>alu a = a - p.</td>
<td>sub a,a,p</td>
<td></td>
</tr>
<tr>
<td>alu p =&lt;&lt; mach + 0x0.</td>
<td>addi.shl p,mach,0x0</td>
<td></td>
</tr>
</tbody>
</table>
2.3.4 File C mode

etpu_asm_converter.exe -c c_input.c out.txt

Table 2. File C mode

<table>
<thead>
<tr>
<th>c_input.c</th>
<th>out.txt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main() {</td>
<td>main() {</td>
</tr>
<tr>
<td>#asm</td>
<td>asm{</td>
</tr>
<tr>
<td>alu c = diob &lt;&lt; 2.</td>
<td>shli c,diob,2</td>
</tr>
<tr>
<td>alu c=17.</td>
<td>movei c,0x11</td>
</tr>
<tr>
<td>/* this is a note*/</td>
<td>// this is a note</td>
</tr>
<tr>
<td>#endasm</td>
<td>)</td>
</tr>
<tr>
<td>callFunc()</td>
<td>callFunc()</td>
</tr>
<tr>
<td>#asm ( alu c = b + a.);</td>
<td>asm( add c,b,a );</td>
</tr>
<tr>
<td>}</td>
<td>)</td>
</tr>
</tbody>
</table>
3 Converter options

3.1 No warnings

When the `--noWarn` option is used warnings aren't reported. This option is useful when converting many files and only the conversion errors are important. For more details about warnings, see the Chapter 5: Limitations.

3.2 Preprocessing

When the `-pp` option is used the file is preprocessed before being converted. The preprocessing is executed using the ccetpu compiler. In the preprocessing stage all the macros are analyzed and replaced with their values. Only after preprocessing the file, its conversion starts. This option is useful with C files that use macros in their inline assembly sections. The converter will not recognize the macros without preprocessing the file first and therefore the option is necessary in such cases.

Note: Using this option will cause white space and new line modifications in the file. Spaces and new lines might be added or removed during the preprocessing stage, and macros will be replaced with their values, but the actual content of the file will not be modified.

When using this option, the input file is passed through the ccetpu C compiler. Therefore, it has to follow eTPU C language rules, for example the file must end with a " `.c" extension.

Example of the `-pp` option:

```
etpu_asm_converter.exe -pp -c c_input.c out.txt
```

Table 3. Preprocessing options

<table>
<thead>
<tr>
<th>c_input.c</th>
<th>def.h</th>
<th>out.txt</th>
</tr>
</thead>
</table>
| #include "def.h"  
#asm  
MY_ALU c = REG_B+ VALUE.  
MY_CHAN pdcm= sm_dt.  
#endasm | #define MY_ALU alu  
#define REG_B b  
#define VALUE 3  
#define MY_CHAN chan | #include "def.h"  
asm{  
addi c,b,3  
chmode.sm_dt }

3.3 Debug information

When the `-debugE` option is used debug information is printed in case of errors. This information may be useful in order to find Byte Craft syntax errors. Note that this option was created for development purposes and therefore in many cases the provided information will probably not be clear or helpful.

This option is mostly useful in chan instruction.

For example:

```
etpu_asm_converter.exe -m -debugE  
chan set flag2.  
error in line 3: syntax error, unexpected FREE_TEXT, expecting FLAG0 or FLAG1.
```
4 Converter operation

The eTPU assembly converter is given a file (or manual data) as an input and produces a new file with all assembly instruction converted from Byte Craft to eTPU Compiler assembly. If the original file compiled correctly according to standard Byte Craft assembly architecture, the converted should convert the file without errors and create a new eTPU compile-ready file.

4.1 Context

The converter is a context independent tool. It analyzes each assembly instruction separately and converts it regardless of any other instructions. The only exception to that rule is macros. The converter has the ability to preprocess c files before converting them and therefore recognize macros in instruction even if they were defined elsewhere in the file (or outside the file), more information about this option in available in the command line section.

4.2 Error handling

When the converter encounters an unrecognized instruction, it reports an error along with the line number of the problematic instruction. Since the converter is context independent, it can continue converting instructions immediately after the error. Therefore, when the converter finishes converting, it is necessary only to manually fix the reported error and there is no need to convert the whole file again. In addition during the conversion, the converter may report warnings. In these cases, the converter was able to convert the specified instruction but there a chance that the conversion wasn't perfect, more information is available at the Chapter 5: Limitations.

4.3 Variables

In c files, variables may appear in inline assembly instructions. The converter does not recognize these variables (since it is context independent). In order to allow variables in inline assembly, the converter copies any text that appears in assembly operands where variables are optional. It is the users’ responsibility to verify that this text refers to a real variable. If no such variable exists the compiler will report an error if it attempts to compile the converted file.

4.4 Parallel instructions

The etpu assembly converter supports parallel instructions. The sub-instructions in parallel instructions are separated by semicolons in Byte Craft.
5 Limitations

This section lists possible limitations to the eTPU assembly converter.

5.1 Complex expressions

The converter does not analyze complex expressions (for example \texttt{alu c=3+6-1+2}), and instead copies them as is (in the above example the converted text is: \texttt{movei c,3+6-1+2}). This approach should deal correctly with most expressions, but some complex expressions may cause issues when converted.

5.2 Negative numbers

The Byte Craft approach to negative numbers isn't consistent: They are treated as 8 bit variables or 24 bit variables in some cases, ignored in other cases and not allowed all together in others. Therefore, the conversion of these numbers is also not completely consistent.

5.3 Macros

Macros in inline assembly are supported but the -pp switch must be used in order to convert them correctly. See the command line section for more information.

5.4 Byte Craft errors

In certain specific cases the Byte Craft compiler doesn't create code in consistent fashion and according to its own documentation. In these cases the converter "fixes" Byte Craft's errors. This solution ensures that the converted eTPU compiler assembly instruction will match Byte Craft's original instruction, however in contrast to most cases the generated binary code of the original instruction and converted instruction will be different (because Byte Craft's instruction doesn't generate the expected code).

For example:

The instruction "\texttt{alu c \gg\gg b+a+1}." generates the binary code \texttt{0x3D330F95} when assembled in the Byte Craft compiler, even though the meaning of this code is to shift \texttt{b+a+1} left instead of right (this seems like a Byte Craft error). The converter will convert the instruction to "\texttt{add.shr.one c,b,a}". As a result the eTPU compiler and Byte Crafts's instructions match (their syntax has the same meaning) but the code each instruction will generate is different (since the converted instruction shifts \texttt{b+a+1} right, and Byte Craft's original instruction shifts them left).

5.5 Unsupported features

All Byte Craft directives besides \texttt{%hex} are not supported. Local Byte Craft labels are not supported as well.
5.6 Parallel instructions

The converter supports parallel instructions. However, there are certain rare parallel instructions which are supported in Byte Craft but not in the eTPU compiler assembler. The Byte Craft compiler supports jmp and end sub-instruction as part of the same parallel instruction, but the eTPU compiler doesn't support such a combination since both jmp and end change the program flow. If the original code contains such an instruction it will be converted without any errors, but the assembler will report an error when the converted instruction is assembled.

5.7 Warnings

5.7.1 ld/ldm

When loading variables which are allocated on the channel the ldm operator should be used, and when loading global variables the ld operator should be used. The converter does not distinguish between those variable and therefore always uses the ldm operator when converting instructions which load C variables. In such cases the following warning is printed: "Instruction has been converted by default to ldm but might be ld depending on the label's value".

5.7.2 Hex directives

The converter supports hex directives which begin with %hex in Byte Craft, and are converted to .word directives in eTPU compiler assembly. However, a warning is still printed when these directives appear because the converter doesn't analyze their meaning. Since there is usually a reason that the original instructions appear in hex instead of Byte Craft assembly, it is recommended to review the converted directive and possibly rewrite the instruction in eTPU compiler assembly.
6 Revision history

Table 4. Document revision history

<table>
<thead>
<tr>
<th>Date</th>
<th>Revision</th>
<th>Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>28-Apr-2011</td>
<td>1</td>
<td>Initial release.</td>
</tr>
<tr>
<td>18-Sep-2013</td>
<td>2</td>
<td>Updated Disclaimer.</td>
</tr>
</tbody>
</table>
Please Read Carefully:

Information in this document is provided solely in connection with ST products. STMicroelectronics NV and its subsidiaries (“ST”) reserve the right to make changes, corrections, modifications or improvements, to this document, and the products and services described herein at any time, without notice.

All ST products are sold pursuant to ST’s terms and conditions of sale. Purchasers are solely responsible for the choice, selection and use of the ST products and services described herein, and ST assumes no liability whatsoever relating to the choice, selection or use of the ST products and services described herein.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted under this document. If any part of this document refers to any third party products or services it shall not be deemed a license grant by ST for the use of such third party products or services, or any intellectual property contained therein or considered as a warranty covering the use in any manner whatsoever of such third party products or services or any intellectual property contained therein.

UNLESS OTHERWISE SET FORTH IN ST’S TERMS AND CONDITIONS OF SALE ST DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY WITH RESPECT TO THE USE AND/OR SALE OF ST PRODUCTS INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION), OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.

ST PRODUCTS ARE NOT DESIGNED OR AUTHORIZED FOR USE IN: (A) SAFETY CRITICAL APPLICATIONS SUCH AS LIFE SUPPORTING, ACTIVE IMPLANTED DEVICES OR SYSTEMS WITH PRODUCT FUNCTIONAL SAFETY REQUIREMENTS; (B) AERONAUTIC APPLICATIONS; (C) AUTOMOTIVE APPLICATIONS OR ENVIRONMENTS, AND/OR (D) AEROSPACE APPLICATIONS OR ENVIRONMENTS. WHERE ST PRODUCTS ARE NOT DESIGNED FOR SUCH USE, THE PURCHASER SHALL USE PRODUCTS AT PURCHASER’S SOLE RISK, EVEN IF ST HAS BEEN INFORMED IN WRITING OF SUCH USAGE, UNLESS A PRODUCT IS EXPRESSLY DESIGNATED BY ST AS BEING INTENDED FOR “AUTOMOTIVE, AUTOMOTIVE SAFETY OR MEDICAL” INDUSTRY DOMAINS ACCORDING TO ST PRODUCT DESIGN SPECIFICATIONS. PRODUCTS FORMALLY ESCC, QML OR JAN QUALIFIED ARE DEEMED SUITABLE FOR USE IN AEROSPACE BY THE CORRESPONDING GOVERNMENTAL AGENCY.

Resale of ST products with provisions different from the statements and/or technical features set forth in this document shall immediately void any warranty granted by ST for the ST product or service described herein and shall not create or extend in any manner whatsoever, any liability of ST.

ST and the ST logo are trademarks or registered trademarks of ST in various countries. Information in this document supersedes and replaces all information previously supplied.

The ST logo is a registered trademark of STMicroelectronics. All other names are the property of their respective owners.

© 2013 STMicroelectronics - All rights reserved

STMicroelectronics group of companies

Australia - Belgium - Brazil - Canada - China - Czech Republic - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan - Malaysia - Malta - Morocco - Philippines - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States of America

www.st.com