Migrating Projects from Arm Compiler 5 to Arm Compiler 6

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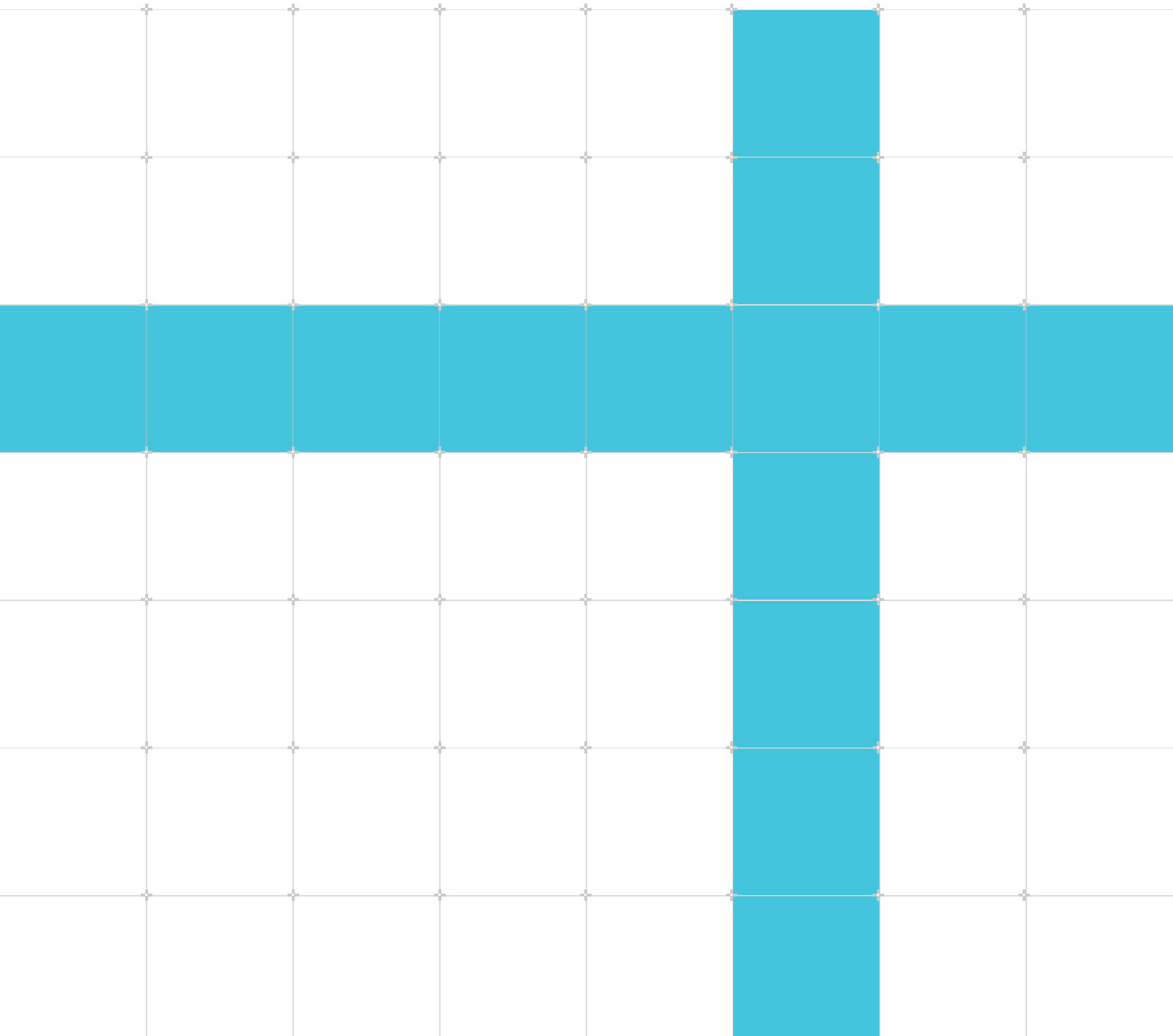

Migrating Projects from Arm Compiler 5 to Arm Compiler 6

Release information

Document history

Issue	Date	Confidentiality	Change
0100-02	11 April 2019	Non-Confidential	First release

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Contents

1. Overview

Follow the steps in this tutorial to migrate an existing Arm Compiler 5 bare-metal project to an Arm Compiler 6 bare-metal project. Once you have completed the migration, you can rebuild your executable and run it on a Fixed Virtual Platform (FVP) model provided with DS-5.

2. The Fireworks project

To show you the steps to migrate your project, this tutorial uses the Fireworks example project built with Arm Compiler 5. This example is included in DS-5. The steps in this tutorial can be easily adapted to work on your individual projects.

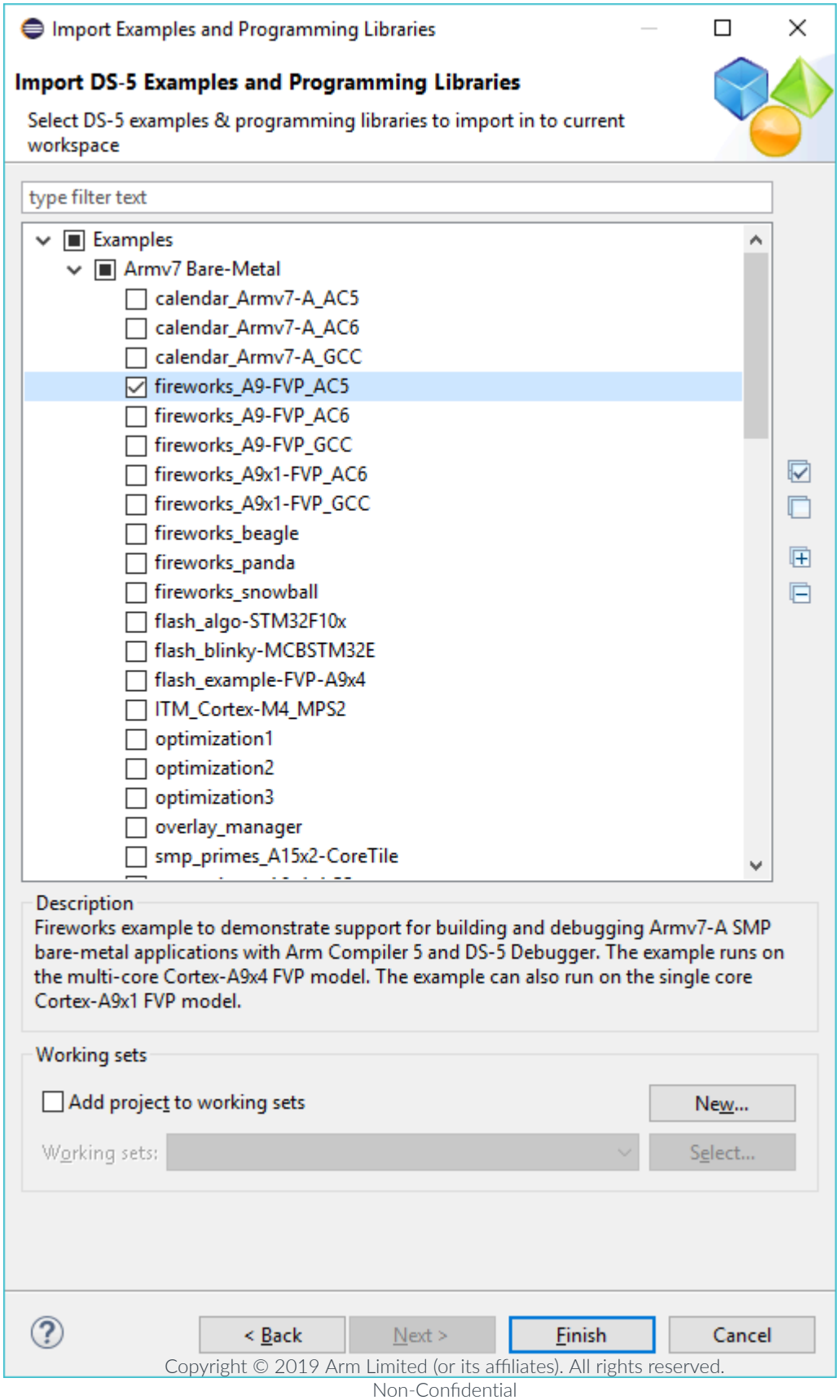
We also provide the Fireworks example built with Arm Compiler 6, but for the purposes of this tutorial, we are ignoring it.

3. Importing the Fireworks project example into the DS-5 Eclipse workspace

To import the Fireworks project example into the DS-5 Eclipse workspace, do the following:

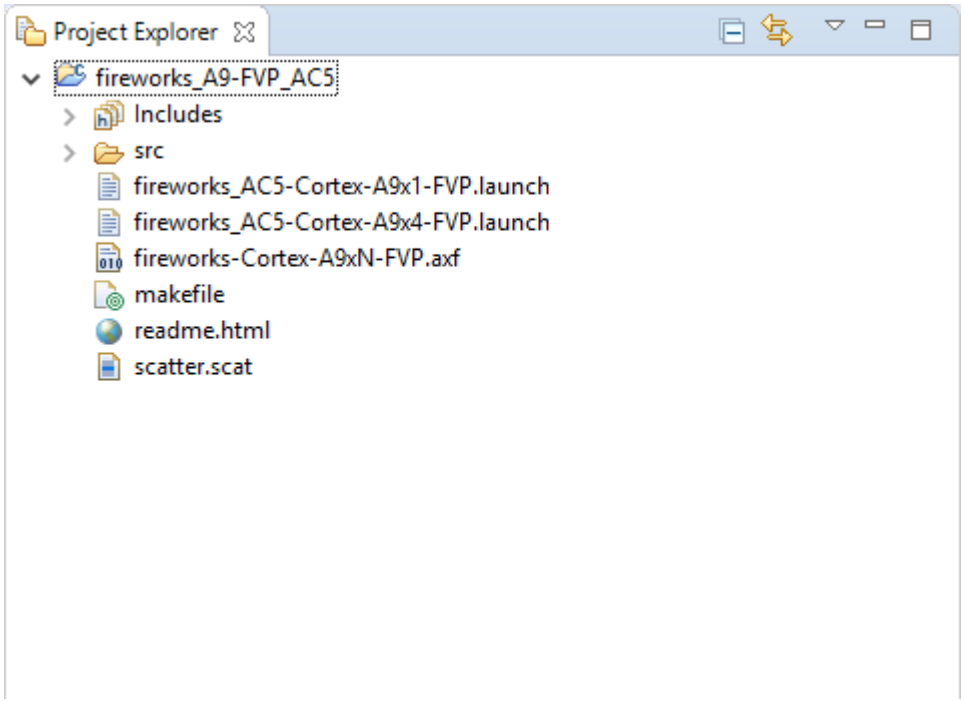
1. Launch Eclipse for DS-5 from the Start Menu.
2. Select a workspace for your DS-5 projects. The default workspace is fine.
3. Close the Welcome screen, if it appears.
4. Select File > Import.... to open the Import Selectio dialog.
5. Expand the DS-5 group and select Examples and Programming Libraries. Click Next.
6. Expand the Examples group, then expand the Armv7 Bare-Metal group.
7. Several Armv7-based bare-metal examples are provided, including startup code and simple applications for a variety of Cortex-A, -R and M-family platforms. For this tutorial, select fireworks_A9-FVP_AC5.

Figure 3-1: Importing the Fireworks project example into the DS-5 Eclipse workspace



8. Click Finish. The Project Explorer view populates with the project. You can view the imported example in the Project Explorer view.

Figure 3-2: Fireworks project example in Project Explorer



4. Building the Fireworks example

To import the Fireworks project example into the DS-5 Eclipse workspace, do the following:

The Fireworks project we just imported is pre-built, that is, the executable is already available in the project. But it is worthwhile rebuilding the project to understand how to start the project build process and to ensure DS-5 is setup correctly.

Depending on your version of DS-5, the imported project may attempt to auto-generate makefiles instead of using the provided one which we will be modifying in this tutorial. To fix this, make sure that generate makefiles automatically is unticked and then remove /Debug from the end of the Build directory path.

You can find these settings by right clicking on the imported example project, then Properties > C/C++ Build.

This will allow DS-5 to use the provided makefile and the makefile to write into the obj directory in the project root directory.

To clean the project, right-click the fireworks project and select Clean Project to remove the contents of the obj directory, if it already exists.

Then, to build the project, you can either:

- Right-click the project and select Build Project, or
- On the main menu, click  button to start the build process. That is it, you have now built your project!

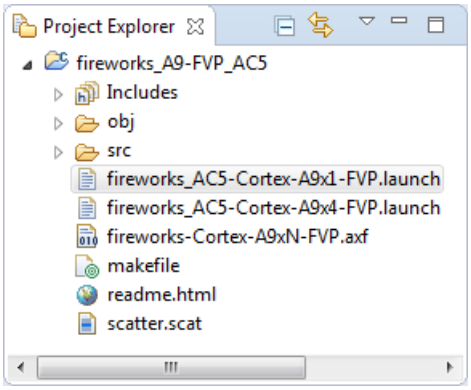
5. Running your application

To run the application you just built, you can use the Cortex-A9 FVP models provided with DS-5.

You can use FVP models to run your image when you do not have access to hardware, for example when the design is not yet completed, or where hardware prototype boards are scarce. Your software development can start early with FVPs which reduces the time to market for your product.

The Fireworks project contains `.launch` files:

Figure 5-1: .launch files



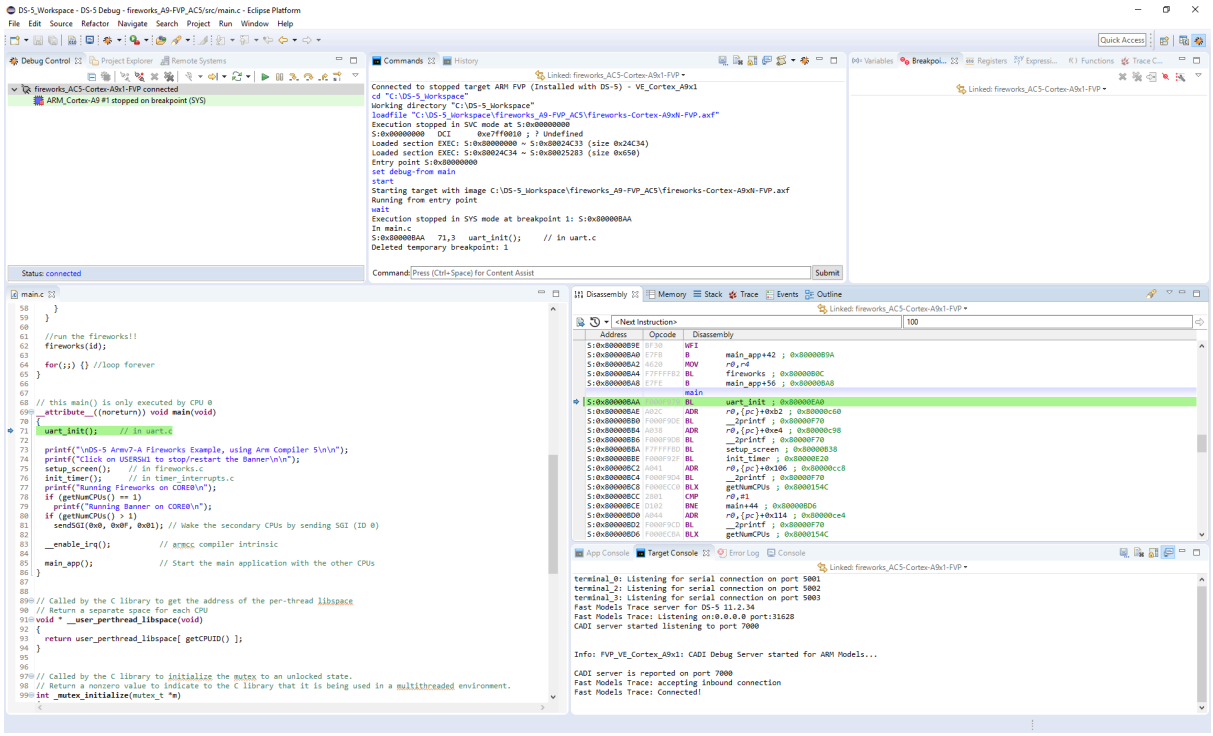
- fireworks-AC5-Cortex-A9x1-FVP.launch - Simulates a single-core Cortex-A9 system.
- fireworks_AC5-Cortex-A9x4-FVP.launch - Simulates a quad-core Cortex-A9 system.

A .launch file instructs DS-5 Debugger what target to connect to, what files to download, which breakpoints to set, and so forth. Launch files are created from the Debug Configurations dialog. We provide them with our examples as an easy method to get you up and running out of the box.

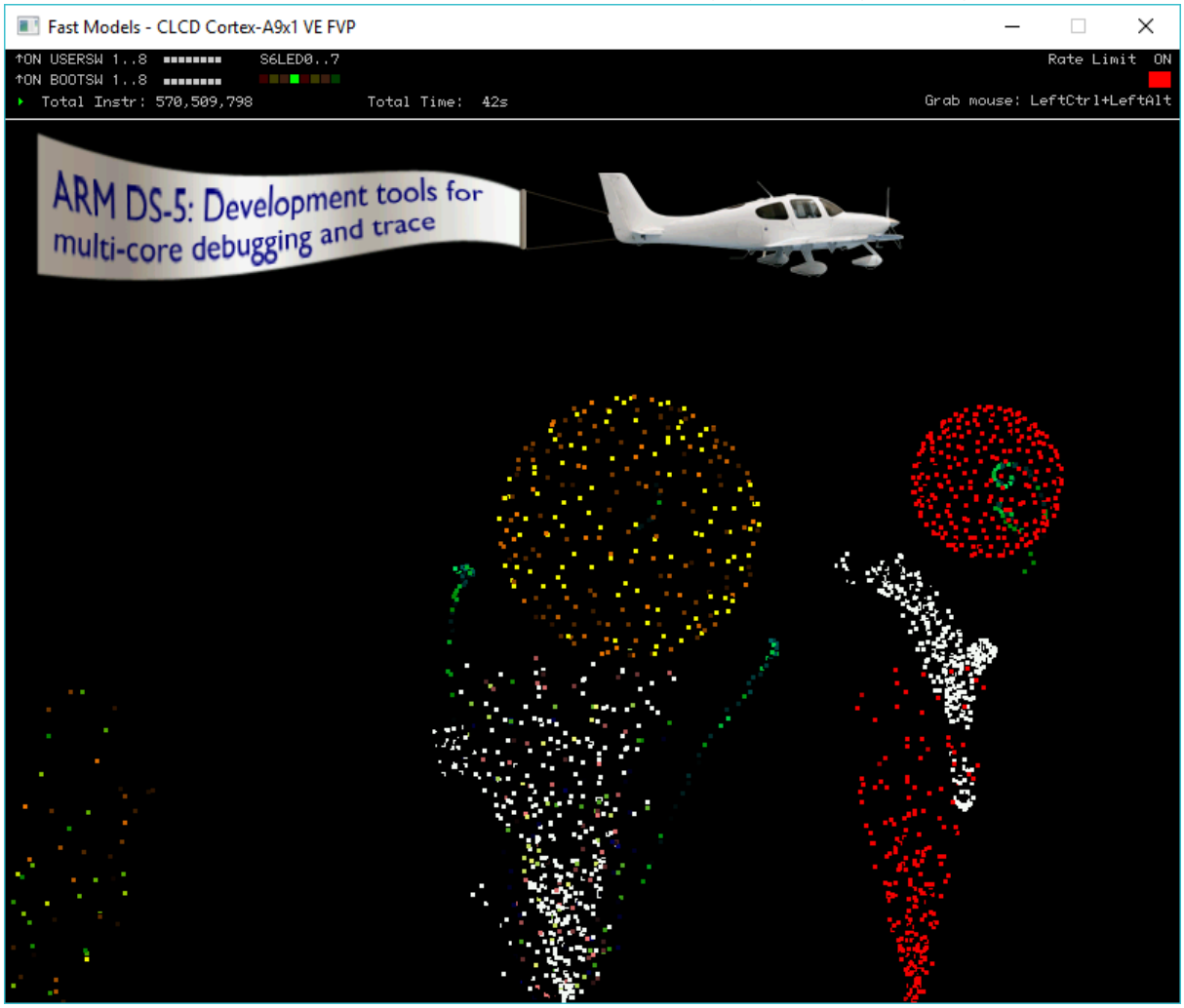
For this tutorial, we are using the single-core configuration:

1. Right-click `fireworks_AC5-Cortex-A9x1-FVP.launch` and select Debug As > fireworks_AC5-Cortex-A9x1-FVP.
2. If DS-5 asks if you want to change perspective, click Yes to switch to the Debug perspective. DS-5 automatically launches the FVP model, downloads the application, sets a breakpoint on the `main()` function, loads debug information into DS-5 Debugger,

and runs to main(). You should get a view similar to the following screenshot:



3. To continue execution, click Button. The fireworks display starts up in a separate window.



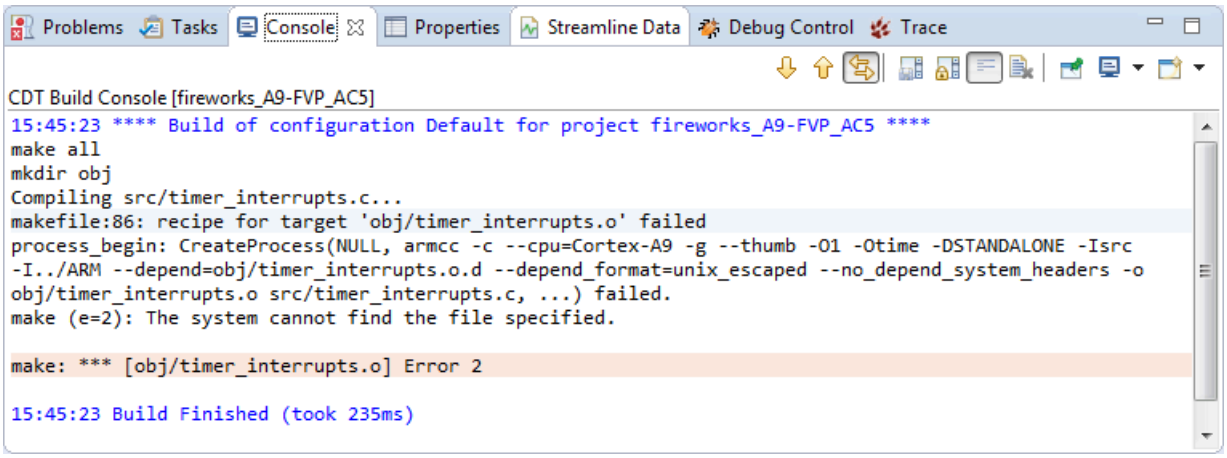
You have now imported the project, rebuilt it, and then run the application on a FVP model. Now, click Disconnect button to stop the simulation.

6. Clean and rebuild the project

Changing the compiler means we have to rebuild all the object files from scratch. Right-click the fireworks project and select Clean Project to remove the contents of the `obj` directory.

The changes are not complete yet, but just to see what happens, we are going to build the project. Right-click the fireworks project and select Build Project. You can view the results of the build in the Console view. The build fails with the error message:

Figure 6-1: Error message



This is because even though we have changed the default compiler for the project to be Arm Compiler 6, the Eclipse project for Fireworks is a makefile project as opposed to a managed project), and the makefile still references Arm Compiler 5 (`armcc`). As part of switching the compiler, you need to make some additional changes to the project for it to build correctly with Arm Compiler 6 (`armclang`).

7. Modifying the makefile

This project uses a `makefile` with the actual compiler calls embedded in it. We need to make changes in the file.

We are going to make changes in two stages:

- In the first stage, we are going to specify which compiler to use.
- In the second stage, we are going to specify which compiler options to use.

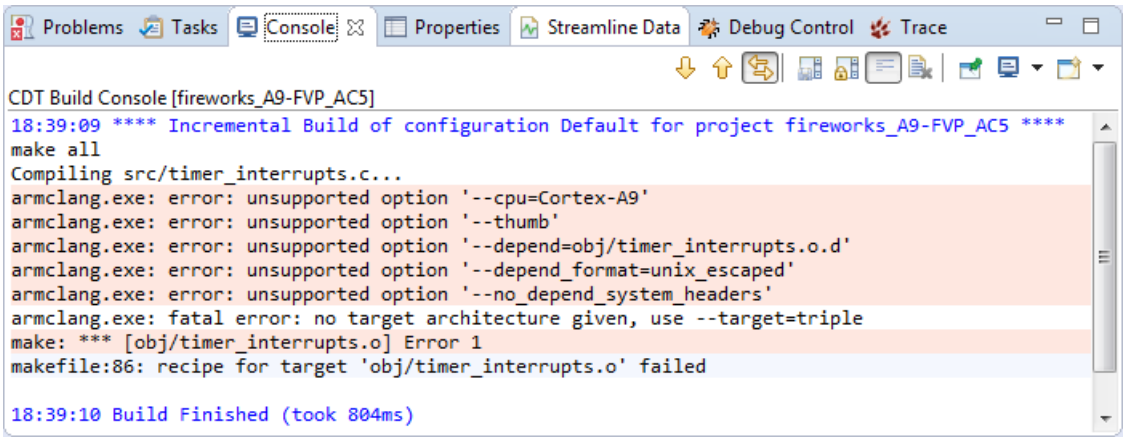
8. Specifying which compiler to use

We are going to specify which compiler to use with the following steps:

1. In the Project Explorer view, browse the `Fireworks` project and locate the `makefile` file.
2. Double-click the file to open it in the editor.
3. Change the entry `CC = armcc` to `CC = armclang`. armcc is the name of the Arm Compiler 5 binary. We are replacing this with the name of the Arm Compiler 6 binary, which is `armclang`.
4. Save the `makefile`.

We have not finished making changes, but to see what happens, right-click and rebuild the project. The build fails with the following errors:

Figure 8-1: error message



This is because the `makefile` is attempting to use `armcc` command-line options with `armclang`. `armclang` and `armcc` use different command-line options. The second set of changes translate the `armcc` options into `armclang` options.

9. Specifying which compiler options to use

With the following steps, we are going to specify which compiler options to use:

1. Locate the below text in the `makefile`:

```
DEPEND_FLAGS = --depend=$@.d --depend_format=unix_escaped
CFLAGS = --cpu=$(CPU) $(DEBUG_FLAGS) --$(CODE_TYPE) -O$(OPT_LEVEL) -O$(OPT_FOR)
 $(DEFINES) $(INCLUDES) $(DEPEND_FLAGS) --no_depend_system_headers $(SUPPRESS)
AFLAGS = --cpu=$(CPU) $(DEBUG_FLAGS) --apcs=/interwork $(DEPEND_FLAGS)
 $(SUPPRESS)
```

2. Replace it with:

```
DEPEND_CFLAGS = -MF $@.d
DEPEND_AFLAGS = --depend=$@.d --depend_format=unix_escaped
CFLAGS = --target=arm-arm-none-eabi -m$(CODE_TYPE) $(DEBUG_FLAGS) -O$(OPT_LEVEL)
 -mcpu=$(CPU) $(DEFINES) $(INCLUDES) $(DEPEND_CFLAGS) -MMD $(SUPPRESS)
AFLAGS = --cpu=$(CPU) $(DEBUG_FLAGS) --apcs=/interwork $(DEPEND_AFLAGS)
 $(SUPPRESS)
```

None of the assembler options (`AFLAGS` and `DEPEND_AFLAGS`) or linker options (`LFLAGS`) need changing since these tools are included in Arm Compiler 6 and are backwards compatible with Arm Compiler 5.

To summarize the changes required in the `makefile`:

Description	Arm Compiler 5	Arm Compiler 6
Change compiler binary name	armcc	armclang
Specify the target architecture	None (only AArch32)	–target=arm-arm-none-eabi
Select CPU	–cpu	-mcpu
Generate Thumb code	–thumb	-mthumb
Optimize for time	-Otime	None (default)
Writes makefile dependency lines to a file during compilation	–depend=$@.d	-MF $@.d
Specifies the format of output dependency files	–depend_format=unix_escaped	None (default)
Disables the output of system include dependency lines	–no_depend_system_headers	-MMD

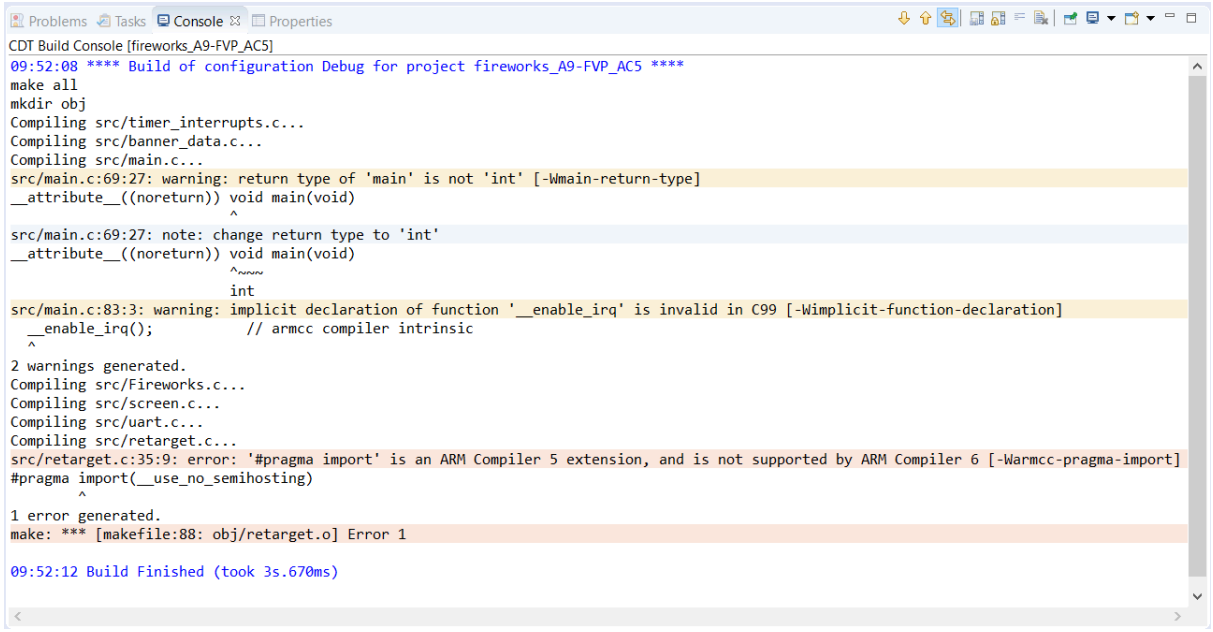
See the Arm Compiler Migration and Compatibility Guide for more information about migrating from older versions of Arm Compiler to Arm Compiler 6.

10. Modifying your code

Now that you have made the necessary modifications to your `makefile`, you have to make some changes to your code.

1. Rebuild the project and view the errors and warnings generated in the Console view:

   Figure 10-1: Console view



2. Diagnose and fix the errors and warnings:
   a. The return type of the main function: void is not allowed in standard C. You can fix this by replacing the following line in `main.c`:

      ```
      __attribute__((noreturn)) void main(void)
      ```

      With

      ```
      __attribute__((noreturn)) int main(void)
      ```

   b. The function `__enable_irq()` is supported by Arm Compiler 6 in a compatibility header file. Add `#include <arm_compat.h>` to the top of `main.c`.

   c. `#pragma import` is not supported by Arm Compiler 6 and must be replaced by the assembler directive equivalent. Replace the following line in `retarget.c`:

      ```
      #pragma import(__use_no_semihosting)
      ```

With

```
asm(".global __use_no_semihosting");
```

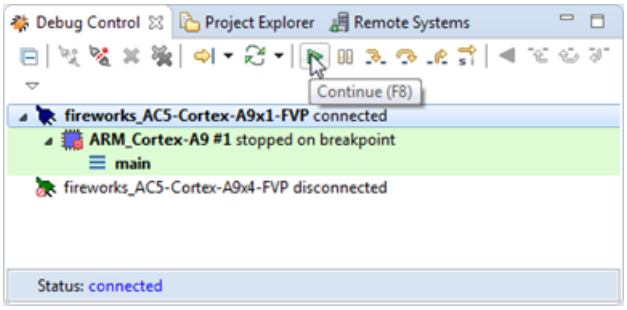
3. Rebuild the project again.

11. Running the modified application

You have completed all required changes to the project and the executable is ready to be run on the FVP.

1. Switch to the DS-5 Debug perspective.
2. In the Debug Control view, either double-click fireworks_AC5-Cortex-A9x1-FVP or right-click and select Connect to target.
3. Click Continue.

Figure 11-1: Running the modified application



You can view the fireworks output running successfully.

12. Converting assembly code

A further step would be to convert the assembler format used from `armasm` format to `GAS` format that can be consumed by `armclang`'s built-in assembler. The instructions are the same in both formats, but the assembler directives, predefined macros and comment characters are different. If you are writing new assembler in `GAS` format, it can be assembled with `armclang -x assembler-with-cpp`.