FTF FREESCALE TECHNOLOGY FORUM 2015

Hands-On Workshop: Mastering **Kinetis Design Studio** IDE - Advanced

FTF-DES-F1149

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External Use

Agenda

- Introduction to Kinetis Design Studio IDE
- Labs:
  - Version Control
  - Build Automation
  - Debug Automation
  - Coverage
- Wrap-up

Overview

- Precondition: Familiar with KDS/Eclipse
- Goal: Exploring advanced possibilities
  - Version Control ➔ Command line build & debug ➔ Coverage

[1]
Version Control
Using Project withVCS/Git

[3]
Debug Automation
Debugging with gdb

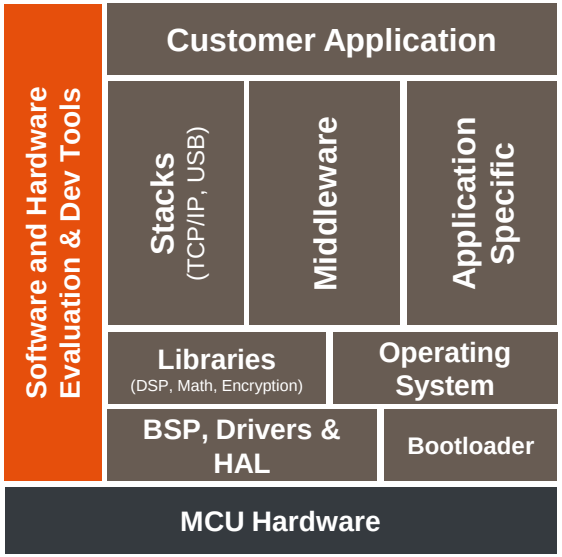
[2]
Build Automation
Building/Generating Code

[4]
Coverage
Gcov with Eclipse

Kinetis Design Studio IDE

No-cost integrated development environment (IDE) for Kinetis MCUs

Eclipse and GCC-based IDE for C/C++ editing, compiling and debugging



Product Features

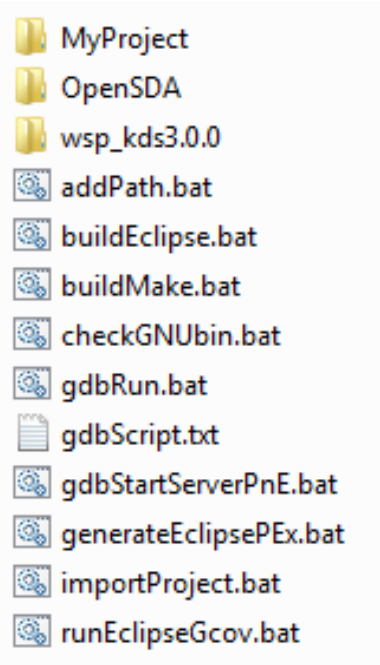
- A free of charge and unlimited IDE for Kinetis MCUs
- A basic IDE that offers robust editing, compiling and debugging
- Based on Eclipse, GCC, GDB and other open-source technologies
- Includes Processor Expert with Kinetis SDK integration
  - Supports all existing Kinetis devices via PEx and new project wizard
  - All new Kinetis devices will also feature the Kinetis SDK with Processor Expert configurability
  - Code Generation for GNU, IAR and Keil
- Host operating systems:
  - Windows 7/8 (32 and 64-bit)
  - Linux (Ubuntu, Redhat, Centos) (64bit)
  - Mac OS X and Segger J-Link
- Support for SEGGER, P&E and Open SDA/CMSIS-DAP debugger targets
- Support for Eclipse plug-ins including RTOS-awareness (i.e. MQX, FreeRTOS)

Learn more at: www.freescale.com/KDS

Community: https://community.freescale.com/community/kinetis-design-studio

Lab Notes

- Lab Computer Password: **CodeWarrior1**
- Lab Files in **C:\FTF\F1149**



- MyProject
  - KDS Project used in Lab
- Batch/script files
  - Simple batch/command files used during the labs
  - Run from cmd.exe (DOS Shell), do NOT just double click on the files!

Please leave the boards/cables/notebooks in the room. We need them for other classes!

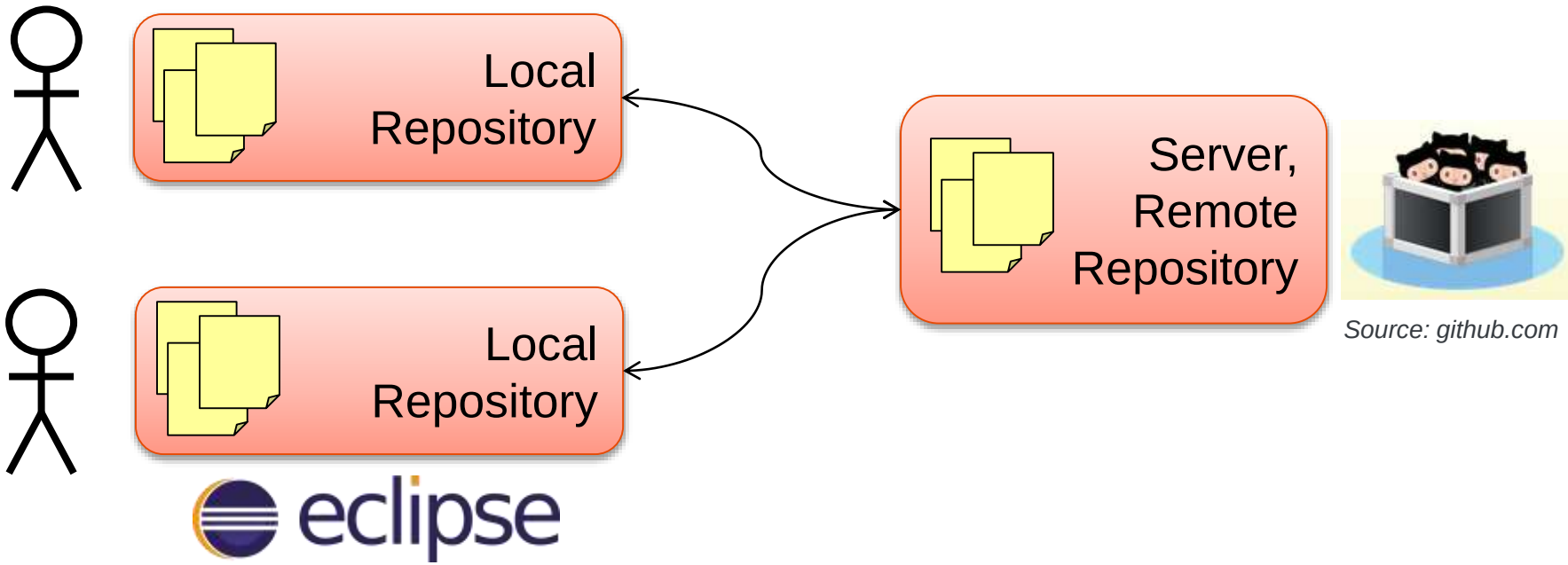
Version Control

Why Version Control?

- Collaboration between multiple developers (same project and files)
- Backup and Restore, Synchronization
- Short-term undo, Long-term undo
- Track Changes, Track Ownership
- Sandbox, Branching, Merging

Typical (Distributed) Version Control System

- Developers work on copy of files (local repository, 'clones')
- Server is managing files in repository (e.g. Git, GitHub)
- Users are connected to repositories with connectors (e.g. eGit in Eclipse)

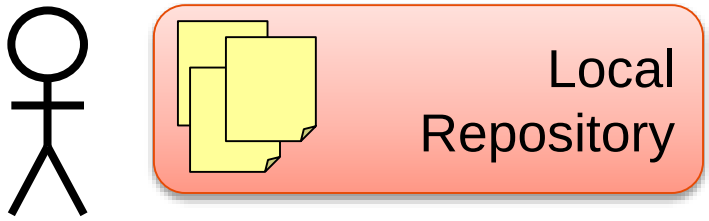


Source: github.com

Source: eclipse.org

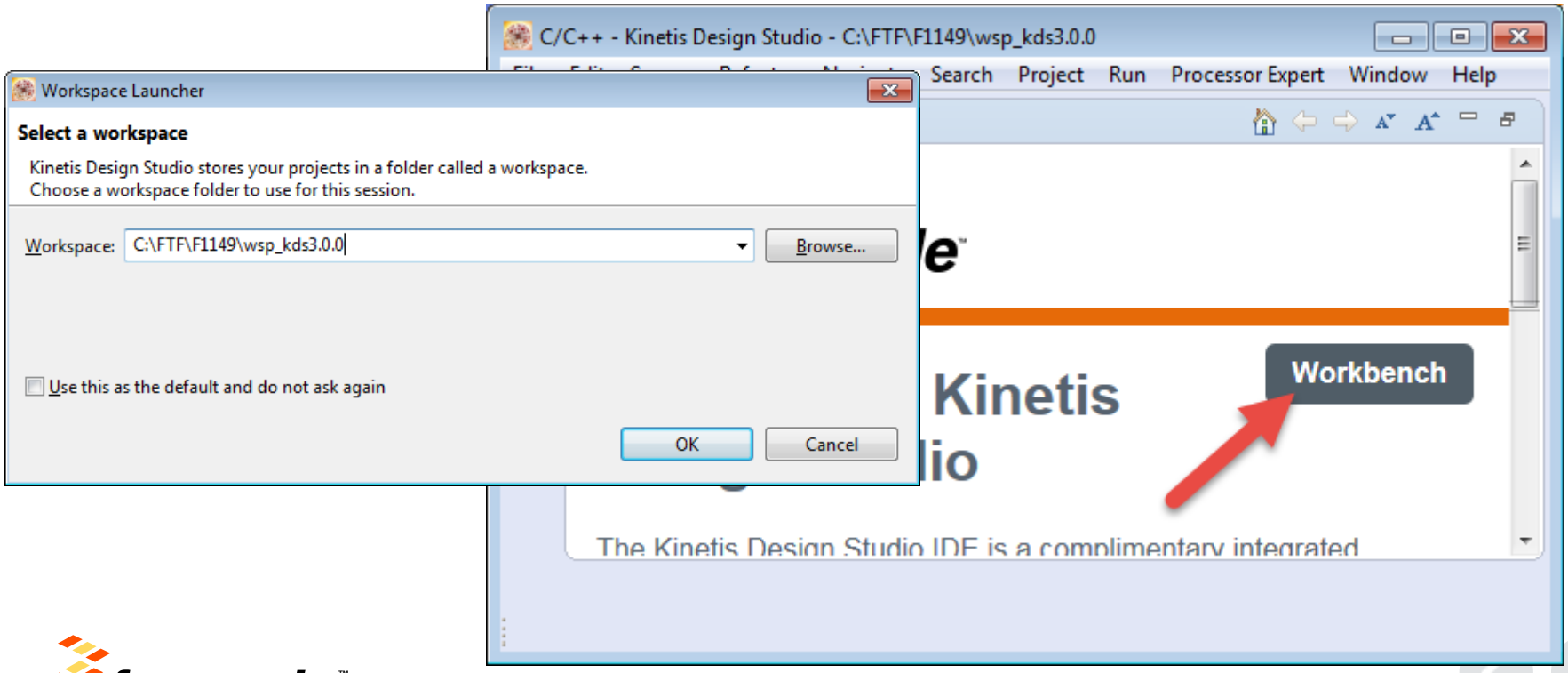
Lab Outline

- Start with a new/empty workspace in Kinetis Design Studio
- Import lab project 'MyProject' into workspace
- Create a new LOCAL git repository
  - no connection to network/GitHub
- Put MyProject under Version Control (git)
  - Add, commit, history, diff, …
- Note: in this lab, we will use a 'personal'/local (not shared on the network) repository



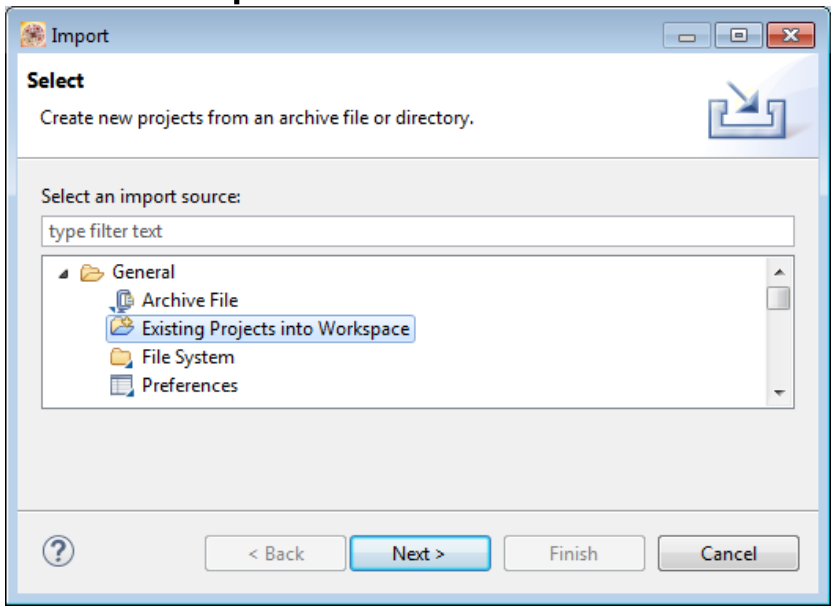
Starting Kinetis Design Studio

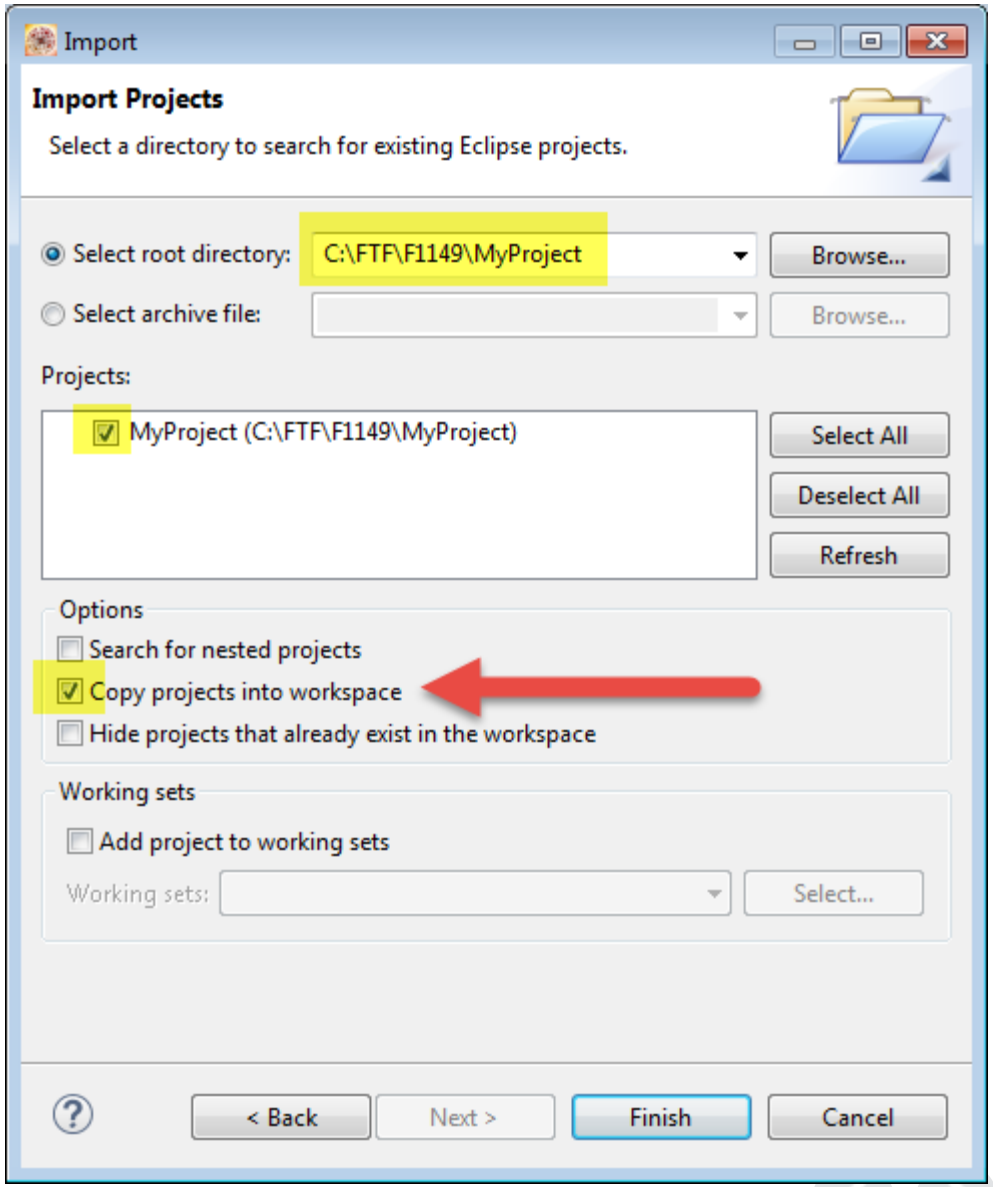
- Start Kinetis Design Studio
- Use following workspace
  - C:\FTF\F1149\wsp_kds3.0.0
- Switch to Workbench



Import Existing Project

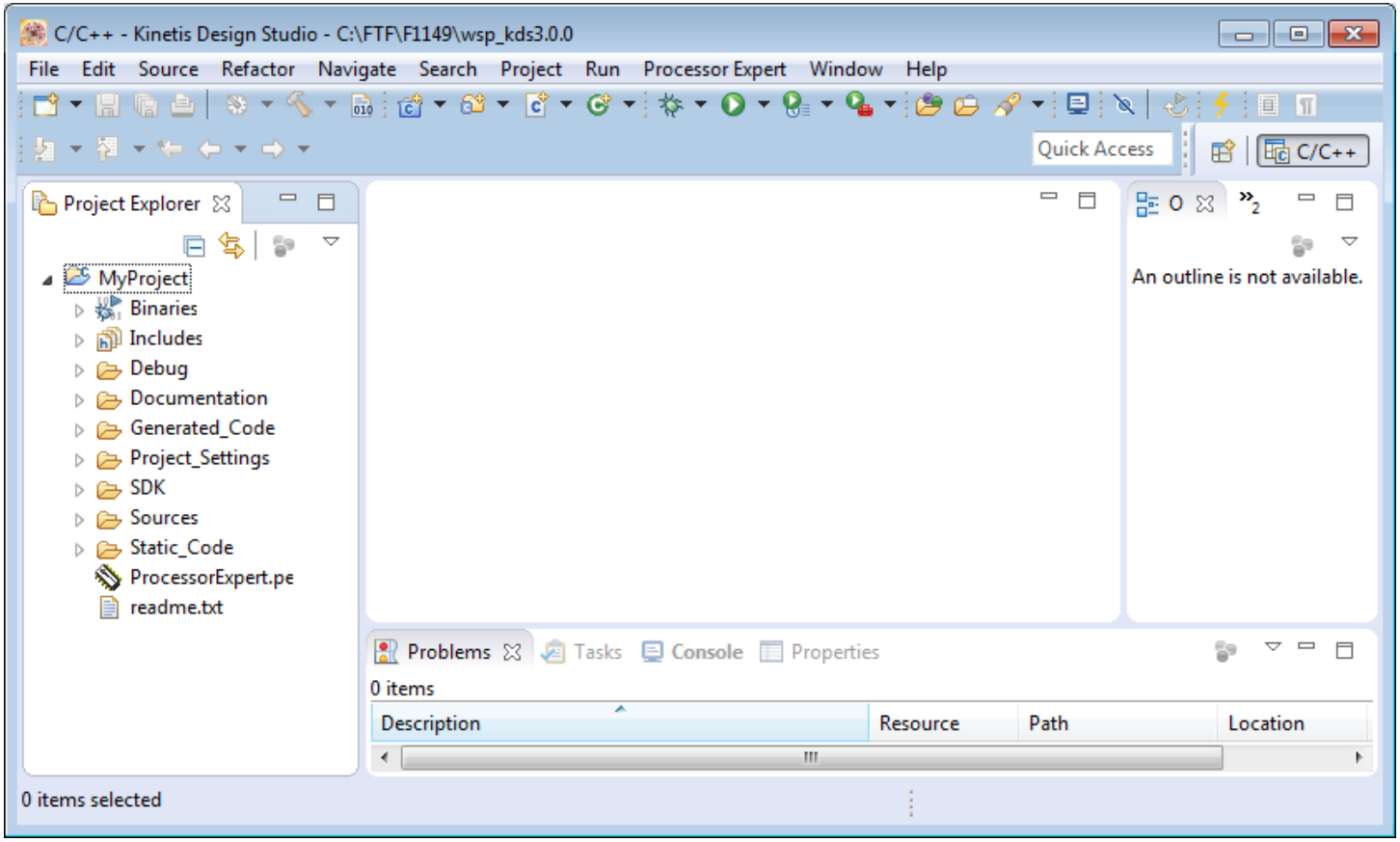
- Menu *File > Import > General > Existing Projects into Workspace*
- C:\FTF\F1149\MyProject
- **Copy** projects into workspace





Project Imported into Workspace

- Project copied into workspace folder
- Project shown in Project Explorer

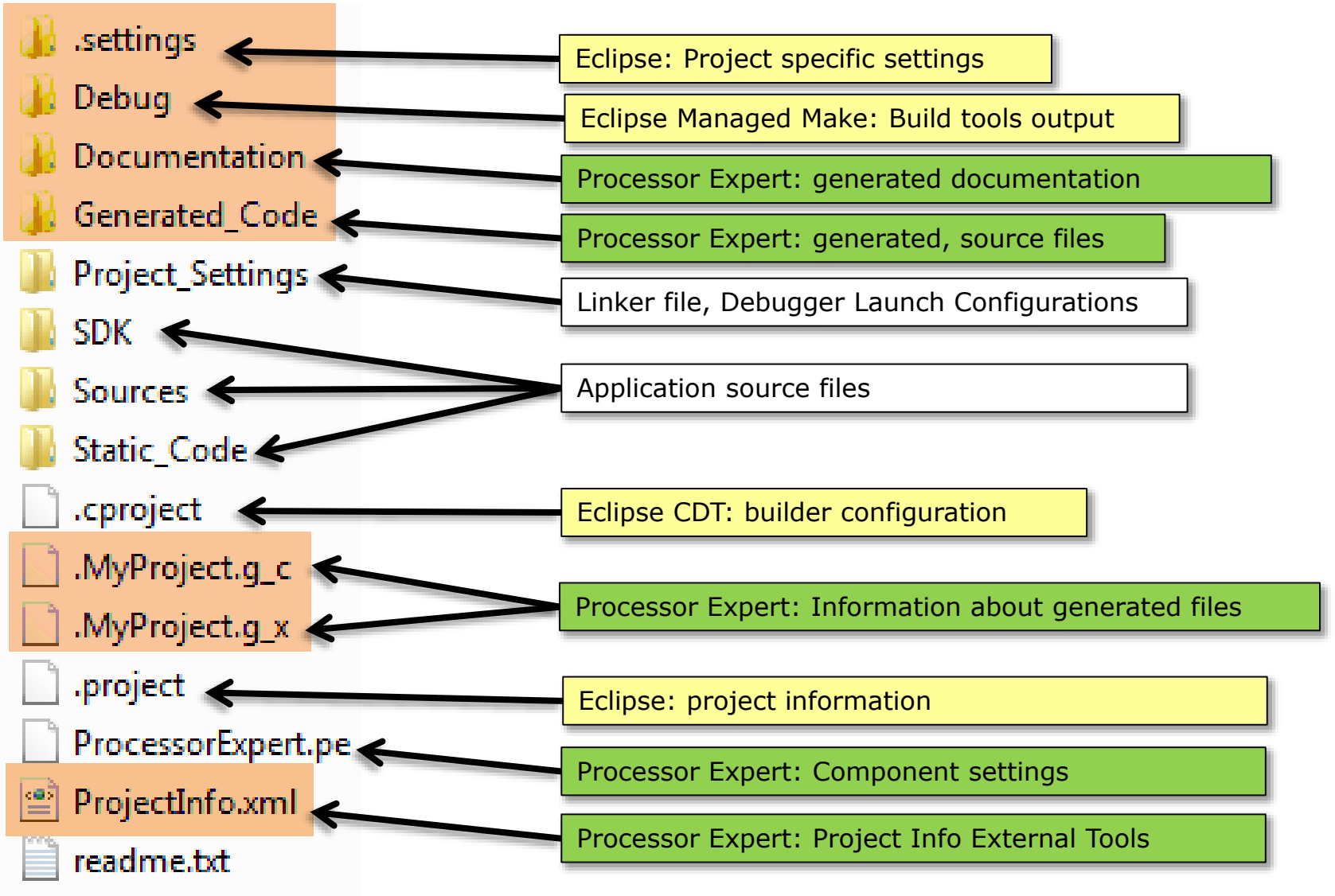


Version Control Rule #1

DO NOT PUT DERIVED/GENERATED FILES INTO A VERSION CONTROL SYSTEM

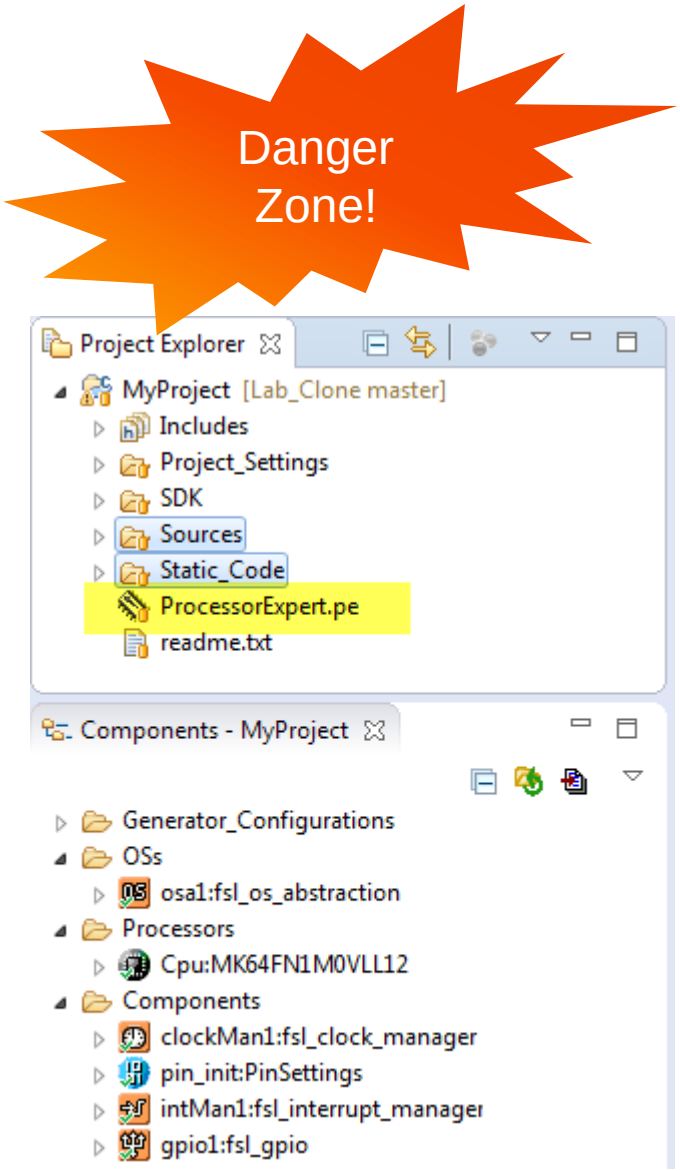
- Files will be generated/created by build
- Putting them into the system only will waste space and create conflicts!
- Need to understand Eclipse & Processor Expert project files

Understanding Project Files and Folders



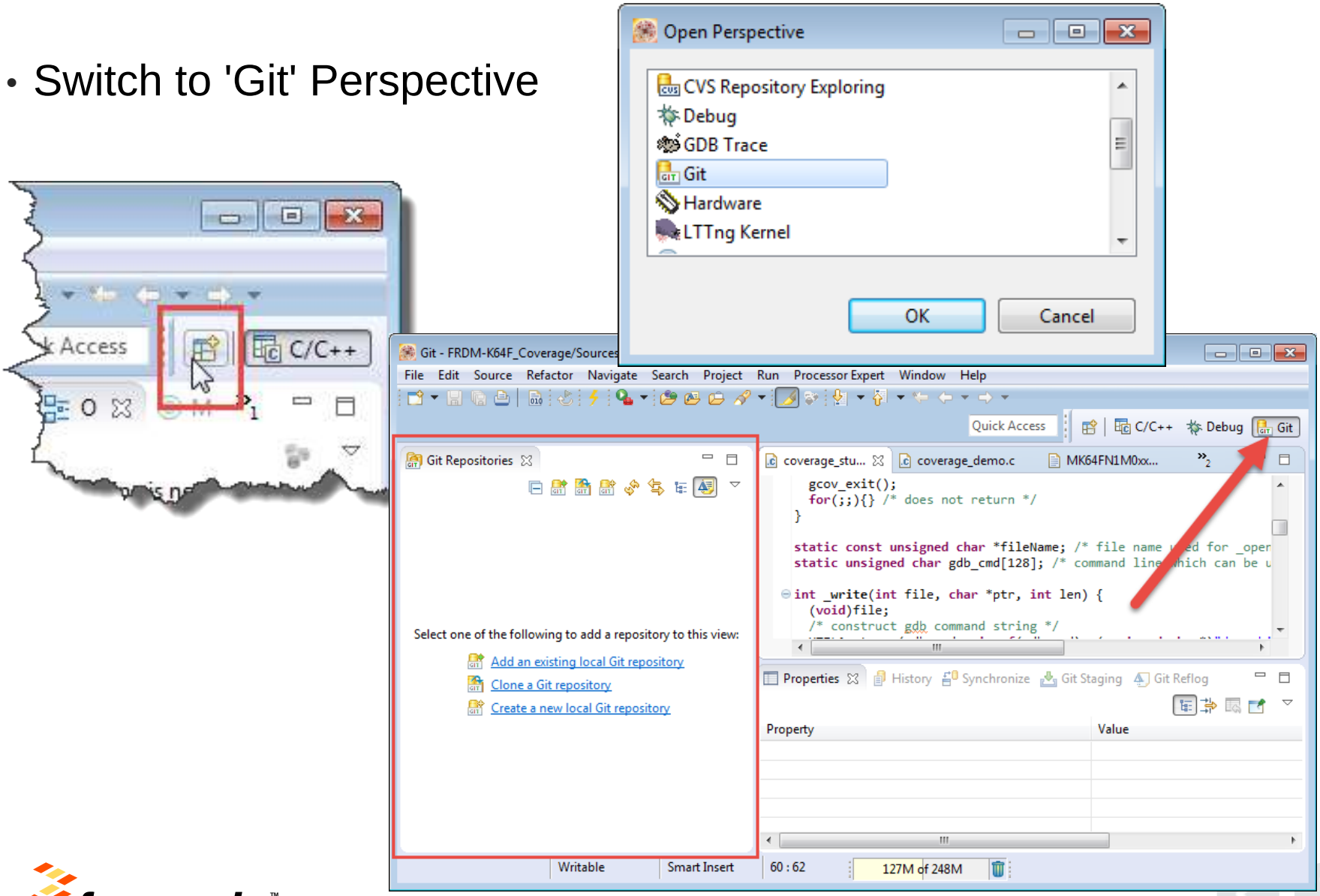
CAUTION: ProcessorExpert.pe Files

- Problem with sharing .pe file with **multiple users**
- XML file with all the Processor Expert settings
  - File can get really huge (several MBytes)
  - Contains components, component settings, etc
- Not ideal for any version control system
  - One user makes a change
  - Likely conflicting with changes from another user
  - Difficult to merge (XML structure)
- Pragmatic approach ☹
  - Handling like a 'binary' file
  - Only one developer does a change, commit
  - All others pull the change



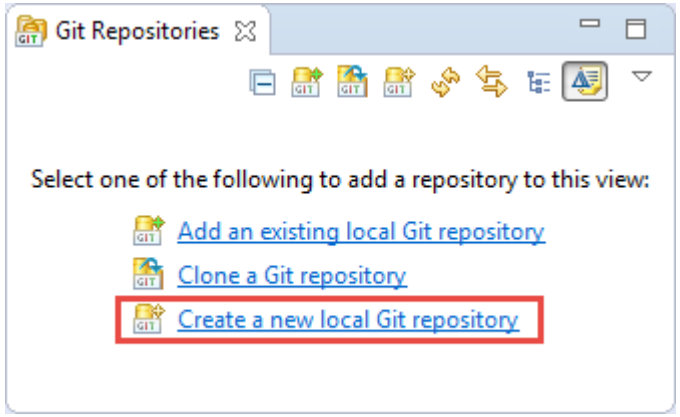
Git Perspective

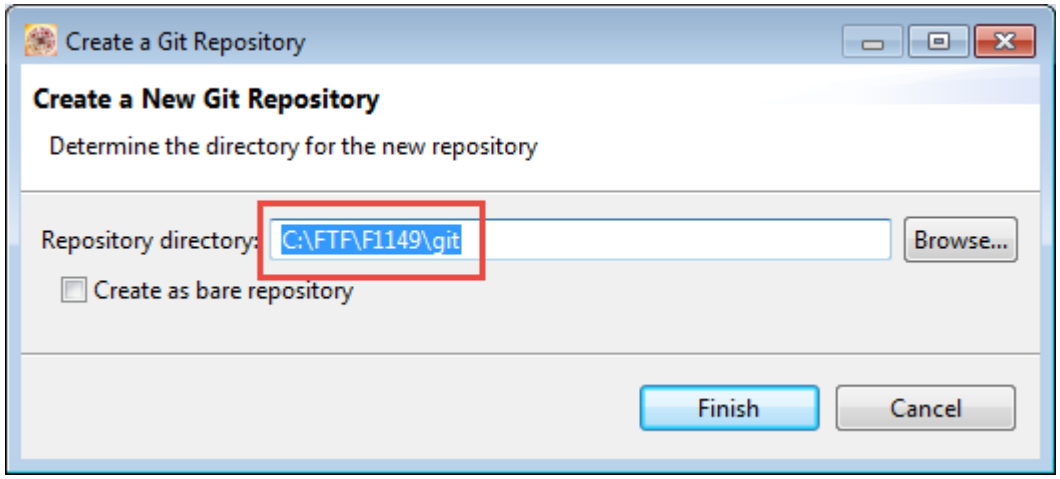
- Switch to 'Git' Perspective



Create a New Git Repository

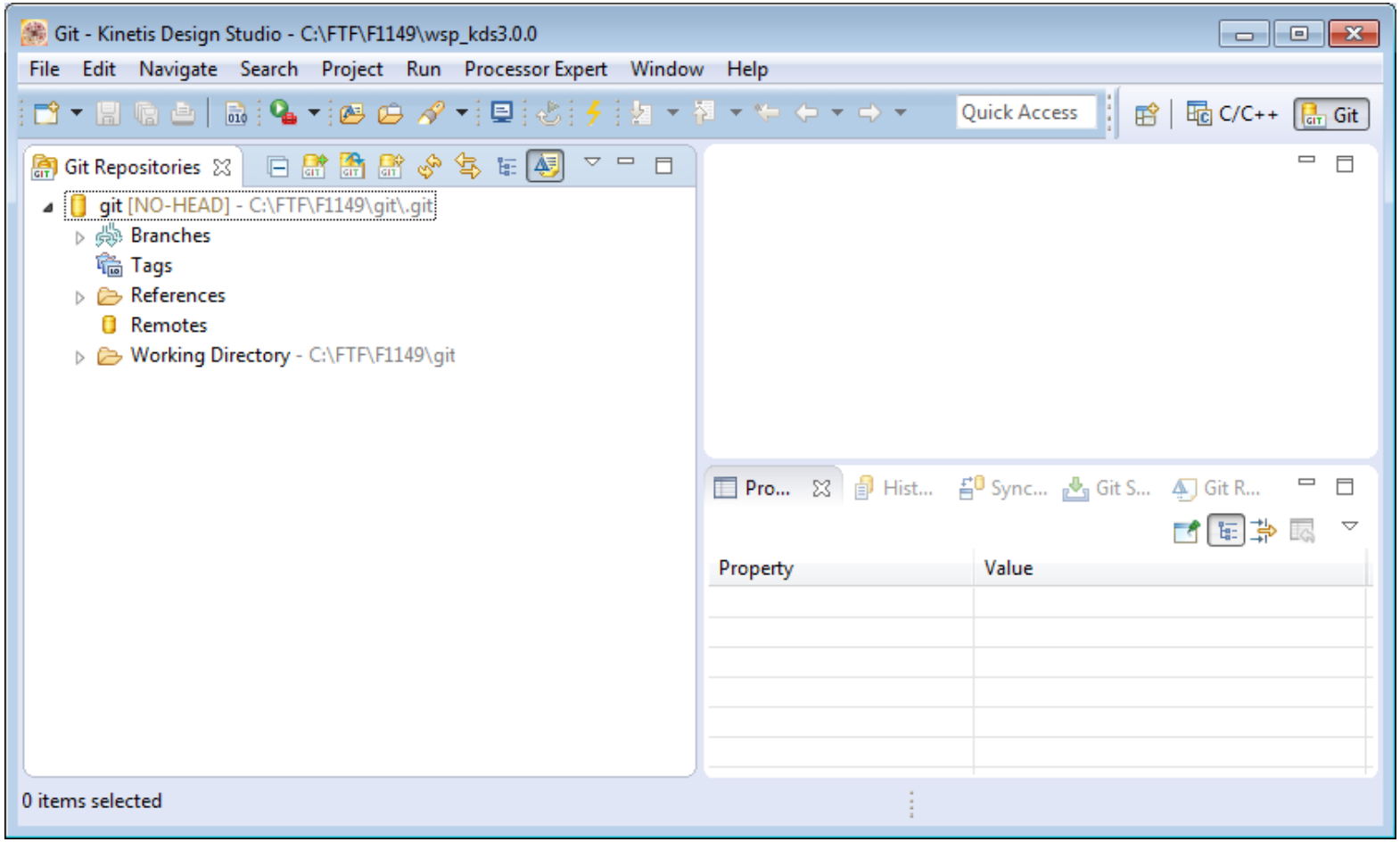
- Create new local Git repository
- Specify repository location/directory
  - C:\FTF\F1149\git
- Note: we are NOT creating a 'bare' repository. A 'bare' one would be used to share it with multiple developers





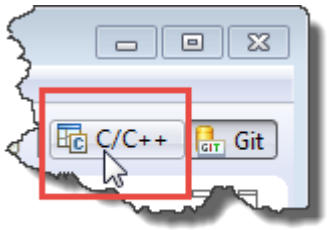
Git Repository

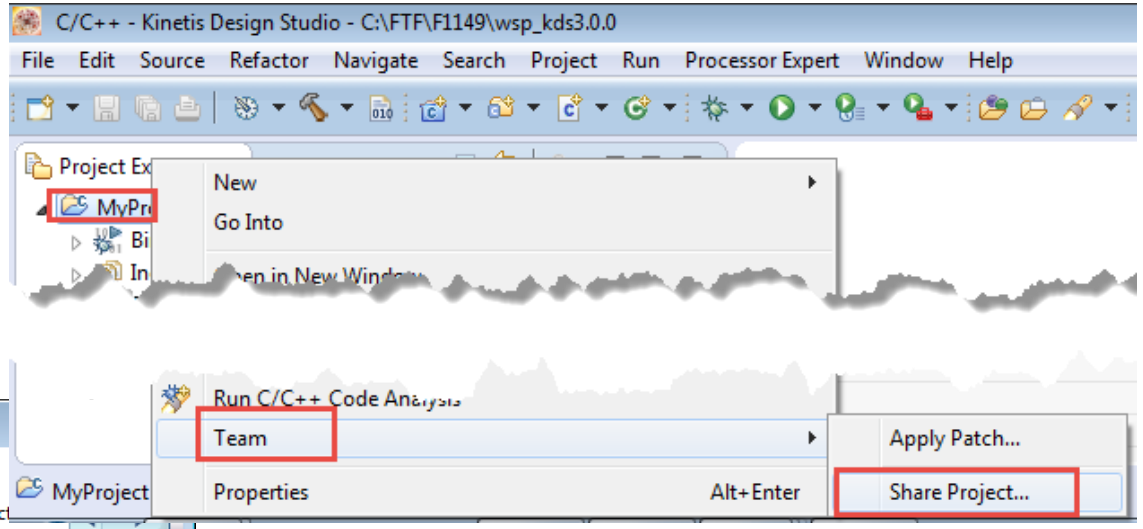
- New repository added to view

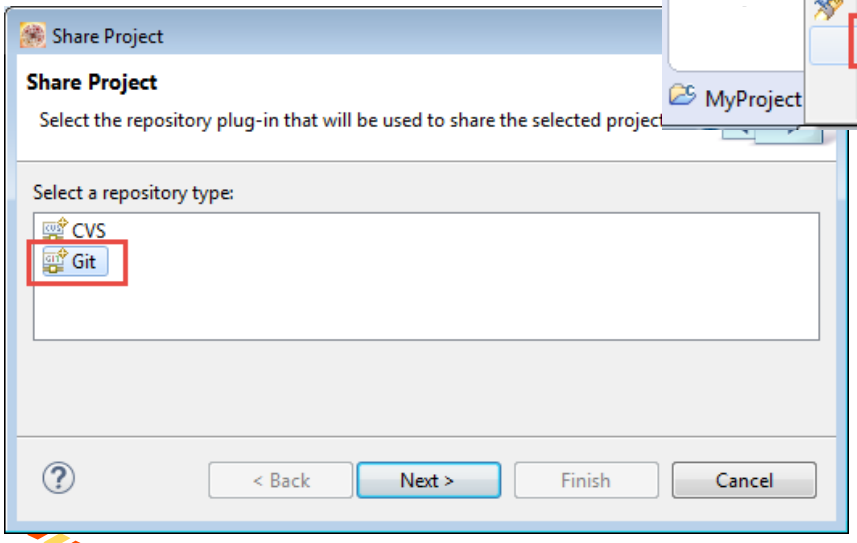


Adding Project to Repository

- Switch to C/C++ Perspective
- Context menu: *Team* > *Share Project*
- Select 'Git'
- Press 'Next'



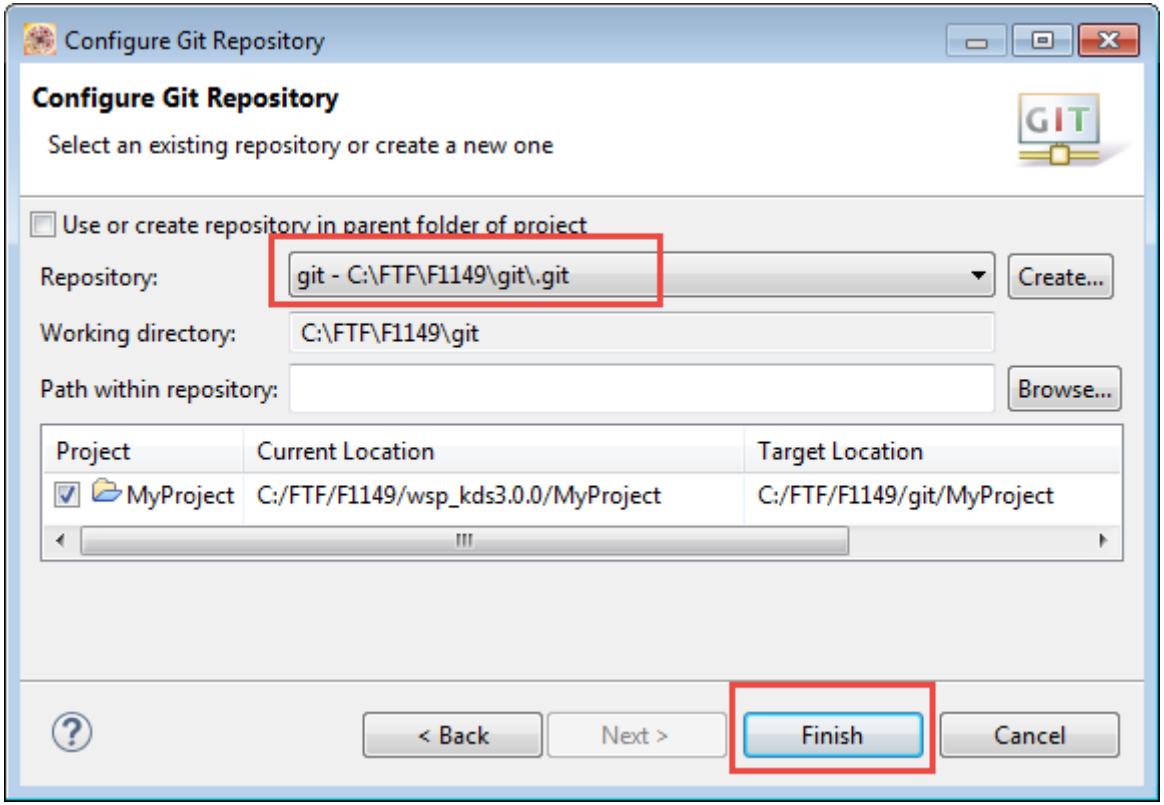




Configure Git Repository

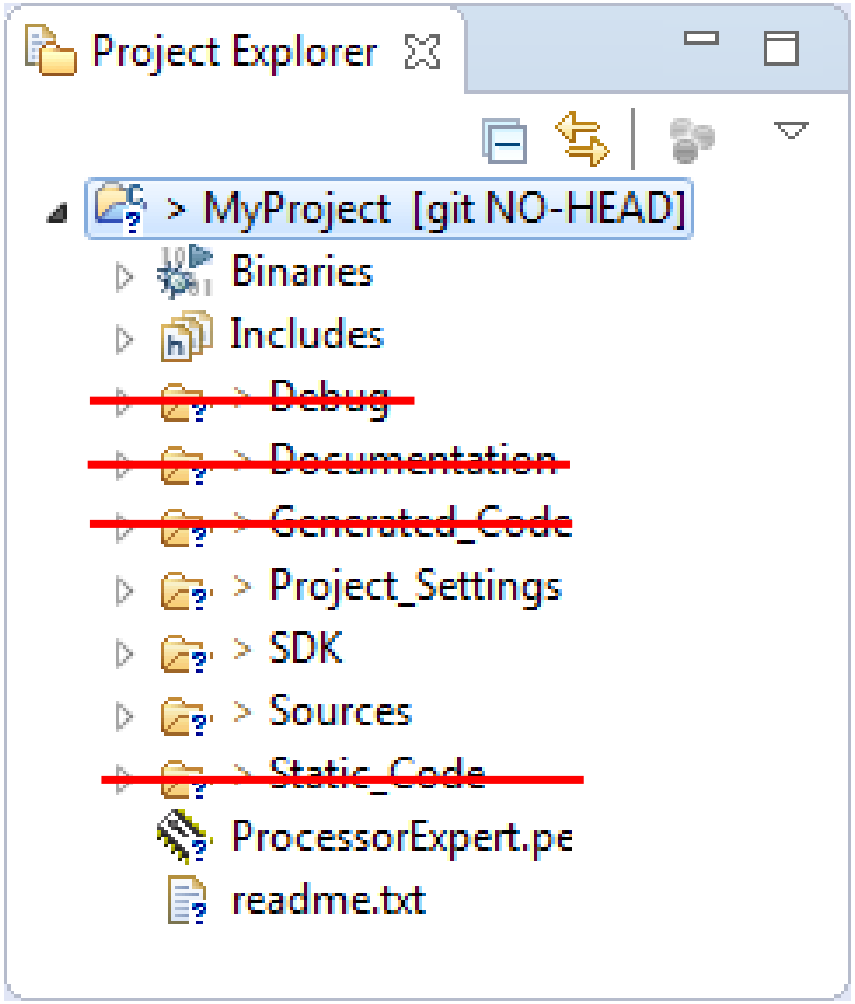
- Select repository previously created
- Press 'Finish'

- NOTE: Project will gets **moved** to repository folder as working copy!



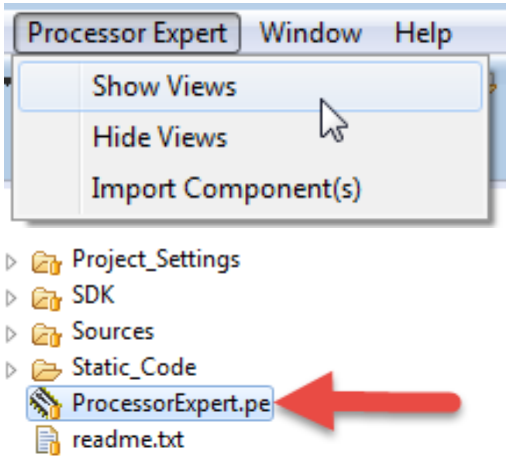
Project Explorer View

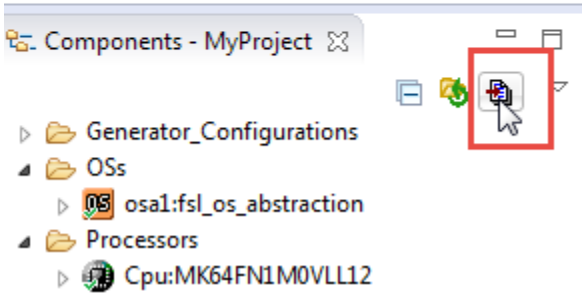
- Files/Folders marked in Project Explorer view
  - '?' means that item has unknown state/not in repository
- As project has moved, delete generated files/folders



Generating Code, Build

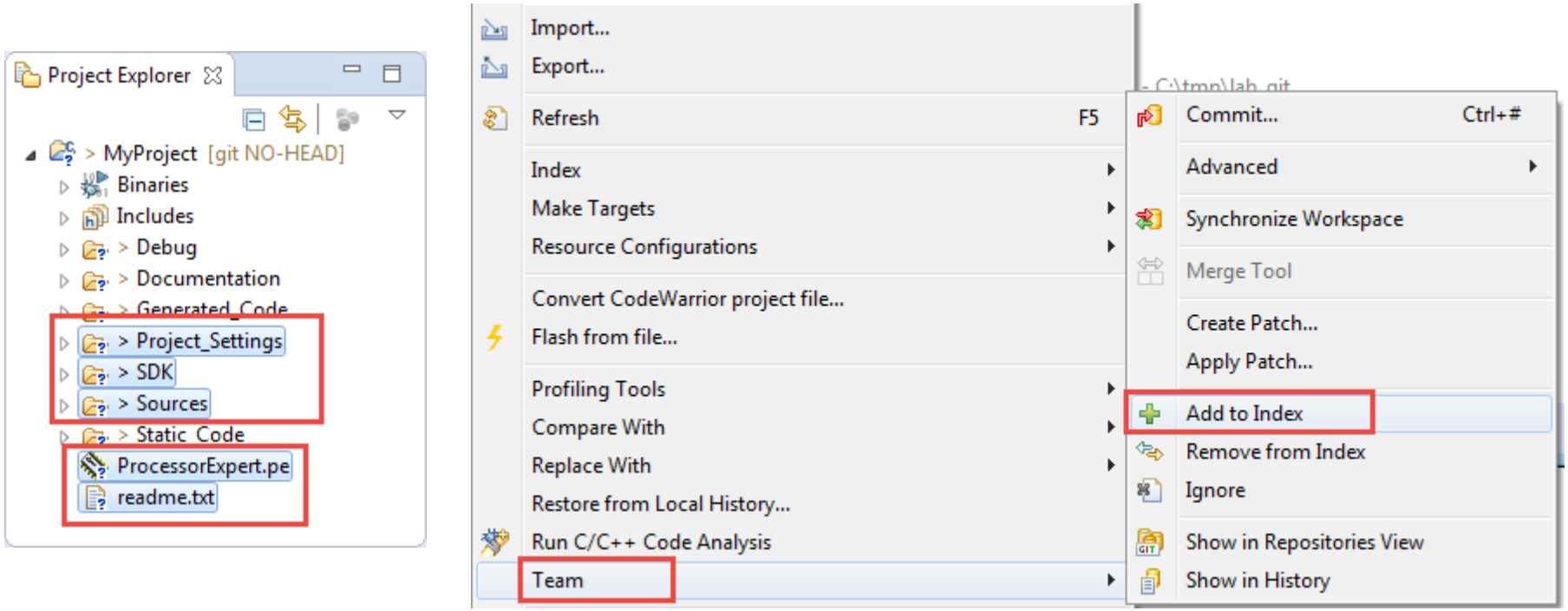
- Menu *Processor Expert > Show Views*
- Select .pe File
- Use 'Generate Code' icon
- Select Project
- Build project





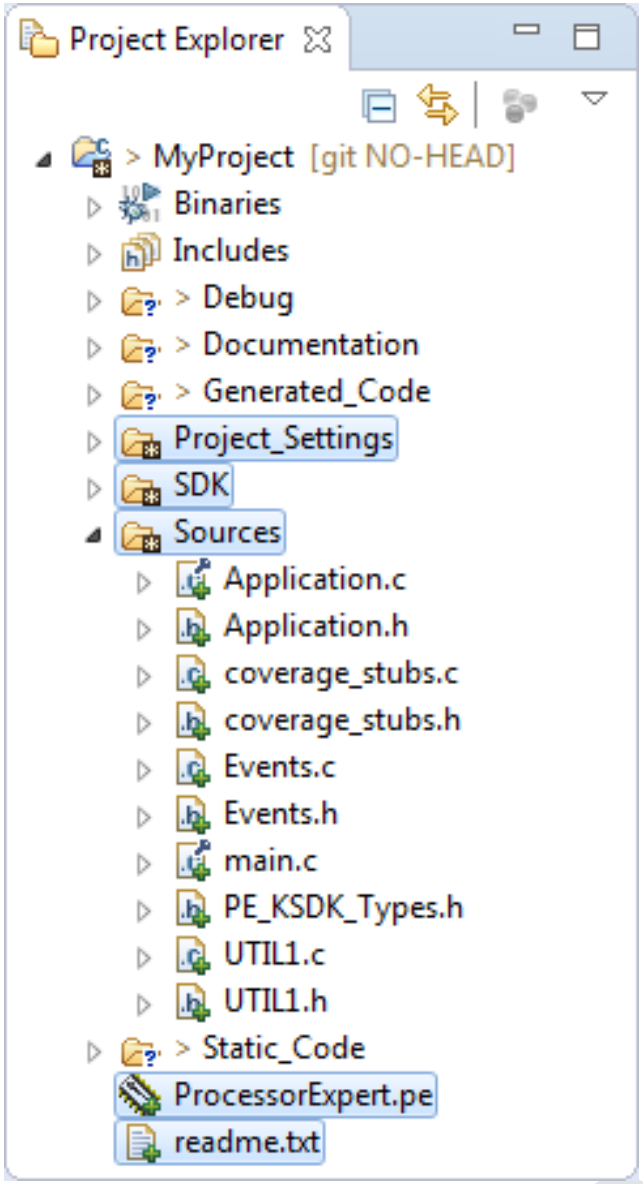
Adding Files to Index

- Select File/Folders to be added
- Context menu: *Team > Add to Index*



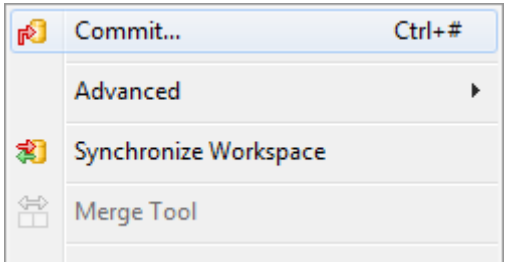
Added Files

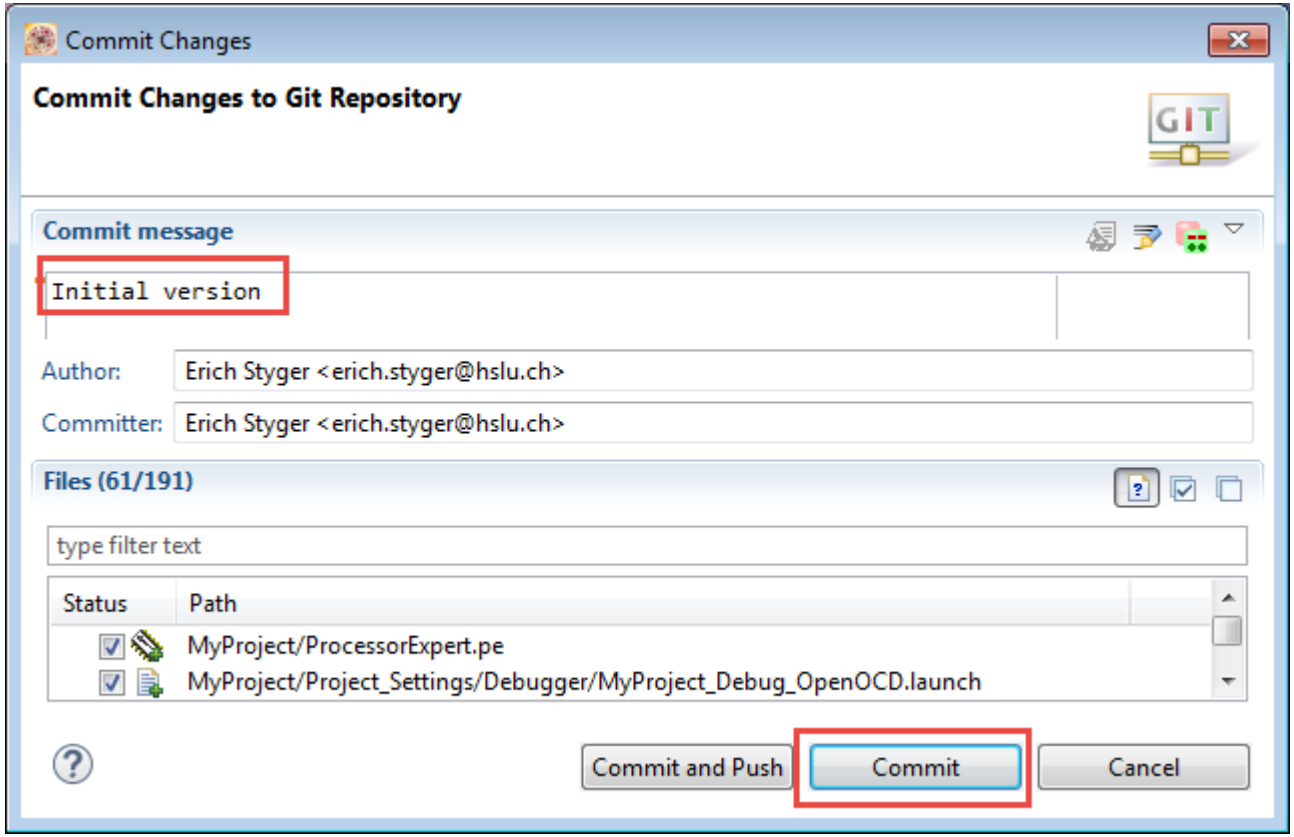
- Newly added files get a '+' decorator
- Files/Folders changed have a '*' decorator
- The have been 'added', but are not 'committed' yet



Commit Changes

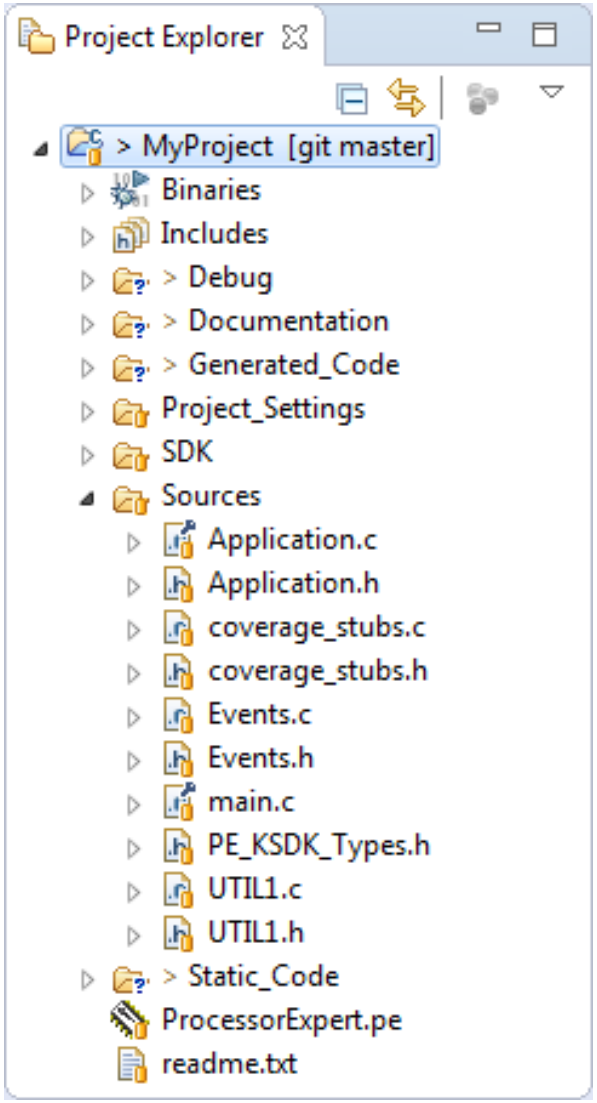
- Use Context menu *Team > Commit*
- Provide commit message
- **Commit** (to local repository)
- If using remote repository: Push





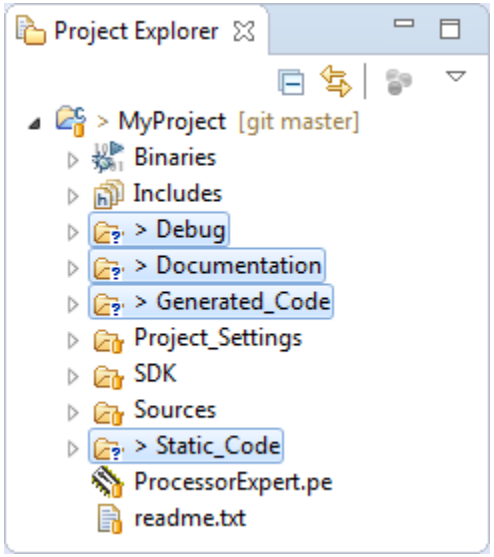
Committed Files

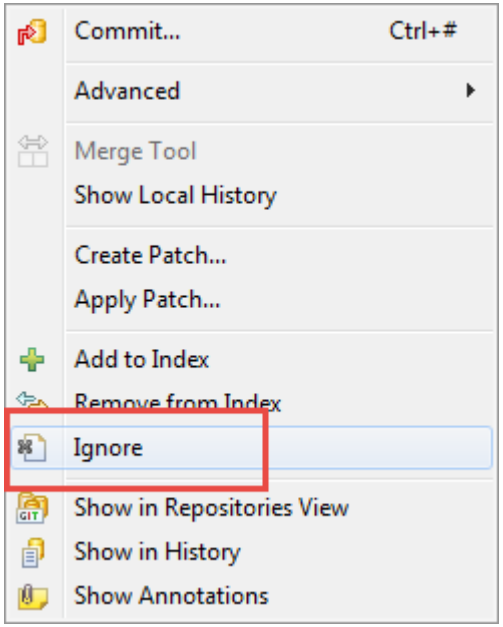
- Files in (local/remote) Repository get 'disk' decorator
- Files with '?' are still 'unknown' to the version control system
  - Need to 'ignore' them

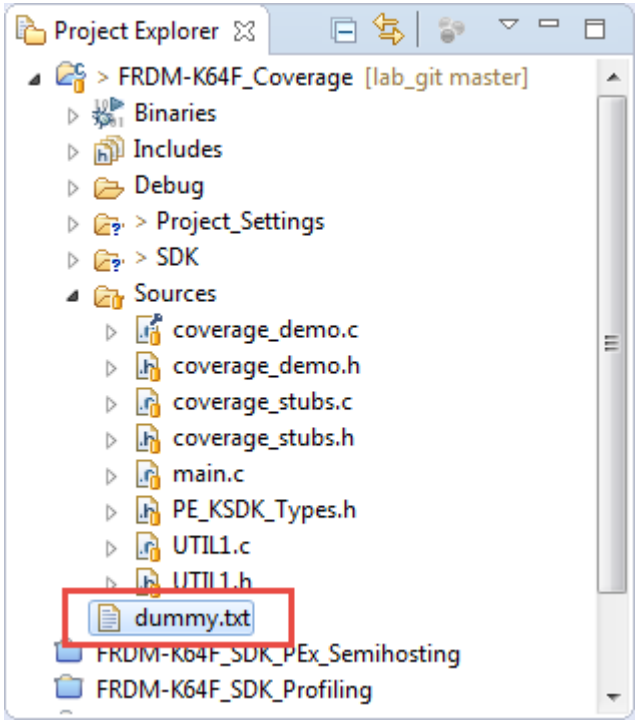


Ignoring Files and Folders

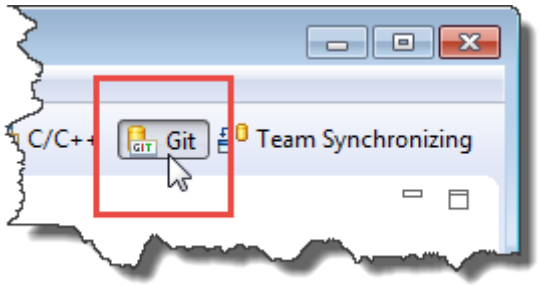
- Select files/folders to be ignored
- Context Menu *Team* > *Ignore*
- Will have '?' icon decorator removed



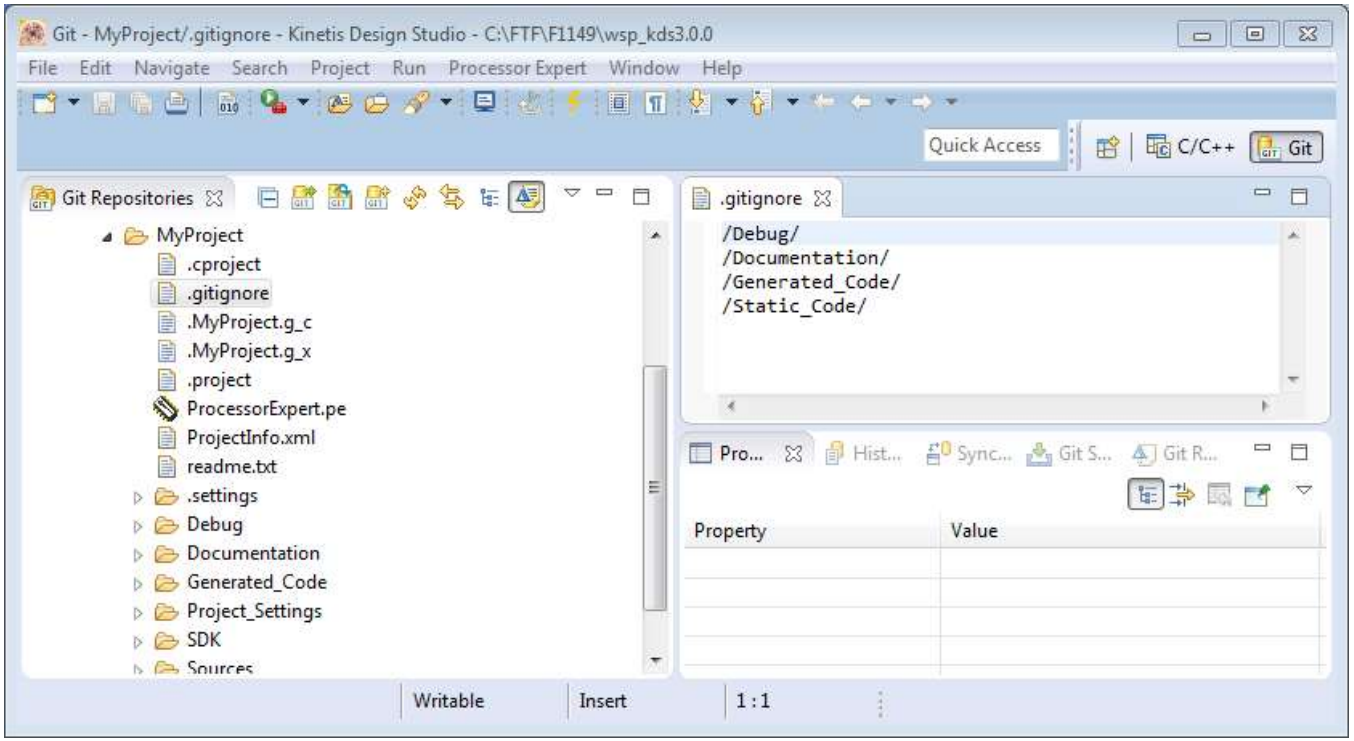




Commit: Ignored Files

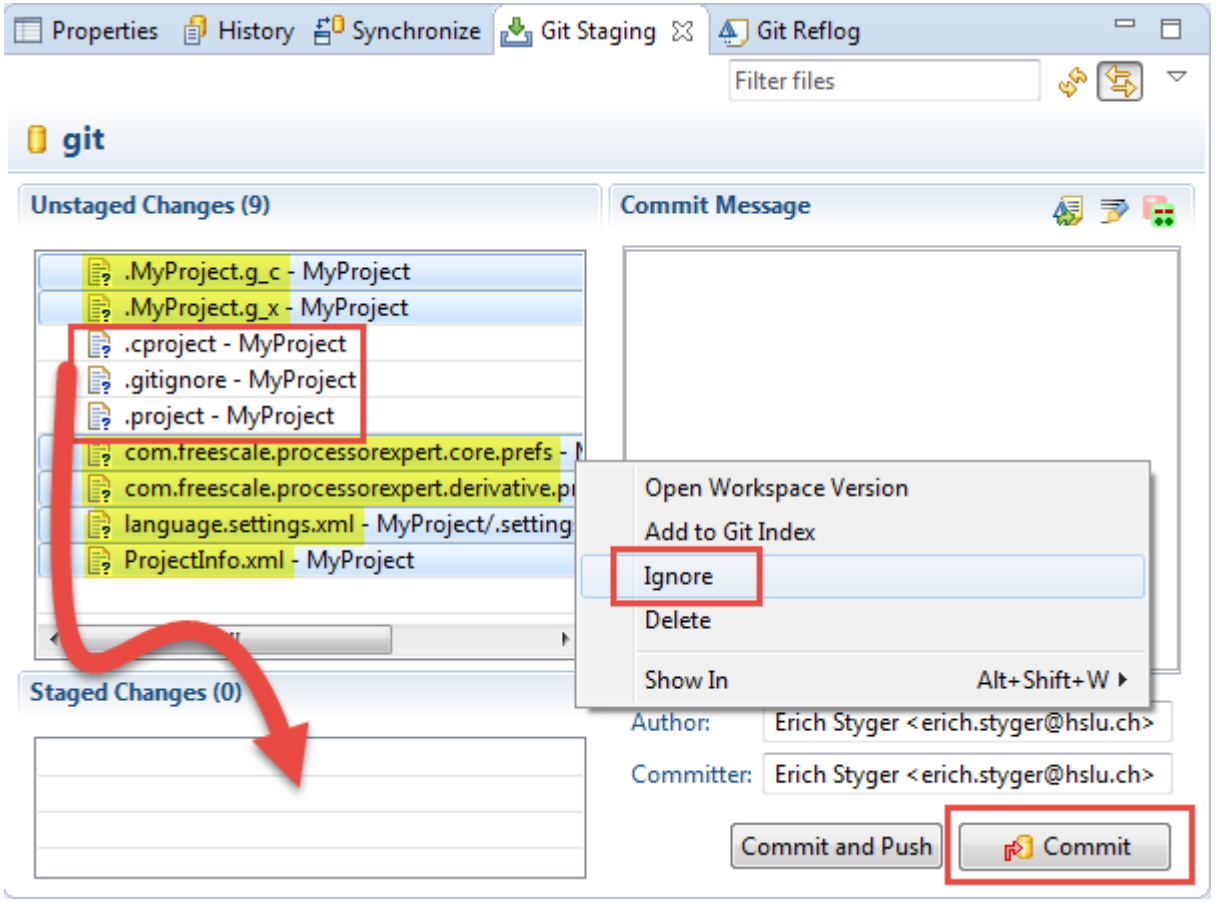


- Switch to Git Perspective
- Ignored files/folders listed in .gitignore file
- Text file
- can have rules or edited with text editor



Git Staging

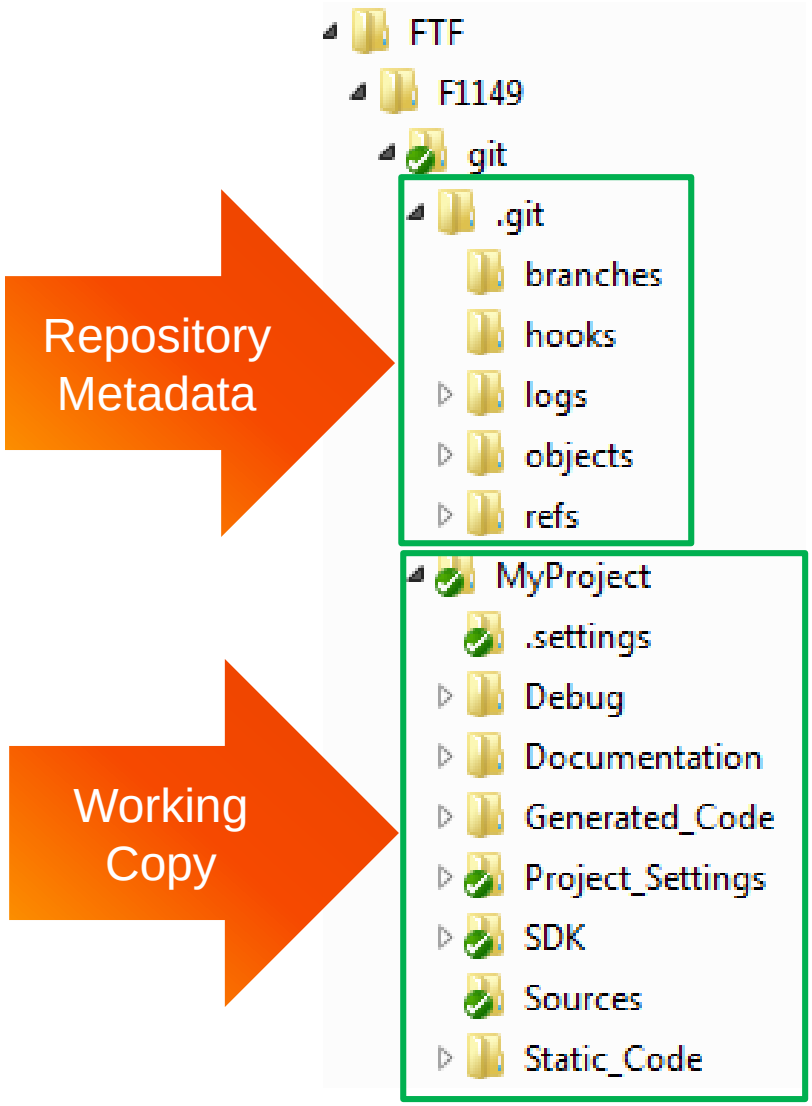
- Not all files are shown in Project view!
- Staging View in Git Perspective
- Drag&Drop files to Stage (add
- Ignore File
- Double click to diff
- **Commit** with commit message



Local Git (not bare) Repository

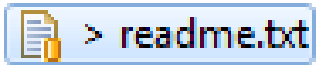
- Git Repository/Database in .git Folder
  - Do not touch it unless you know what you are doing!
- With the Import into Git, our project has moved as 'working copy' into the local repository structure

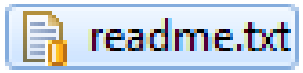
- *NOTE: a **local** repository like this is not intended be shared with other developers. For this, a special 'bare' repository followed by a 'clone' would be necessary.*

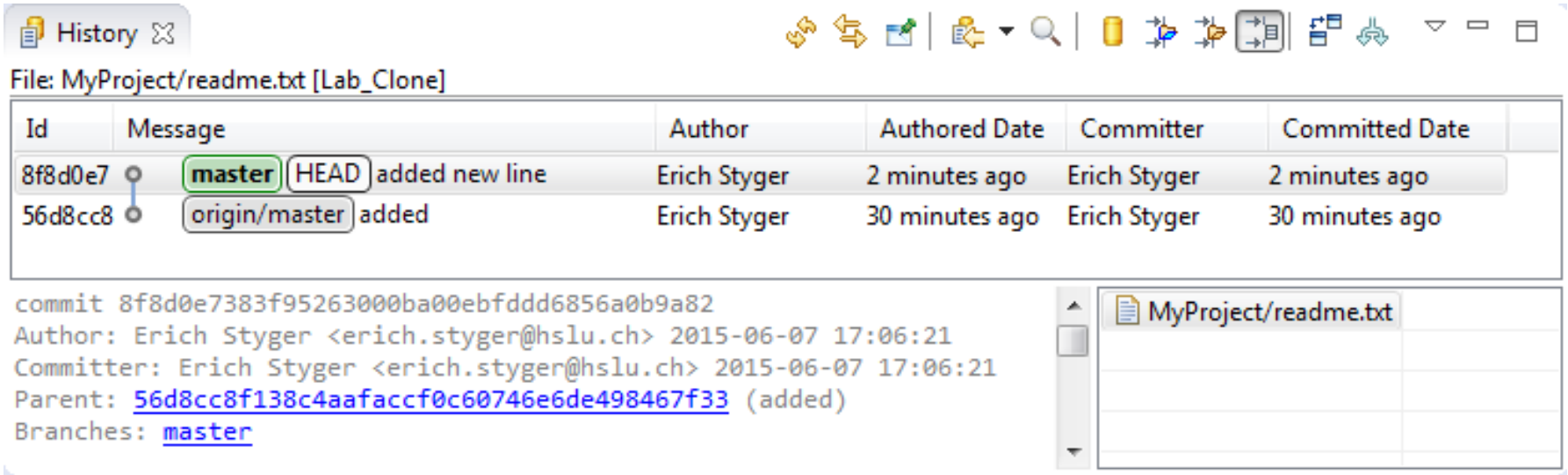


History

- Edit a file and save it
  - Gets '>' marker to indicate change
- Commit it with context menu: *Team > Commit*
- Context menu *Team > Show in History*
  - History of files and changes
  - Double-click on line to open that version

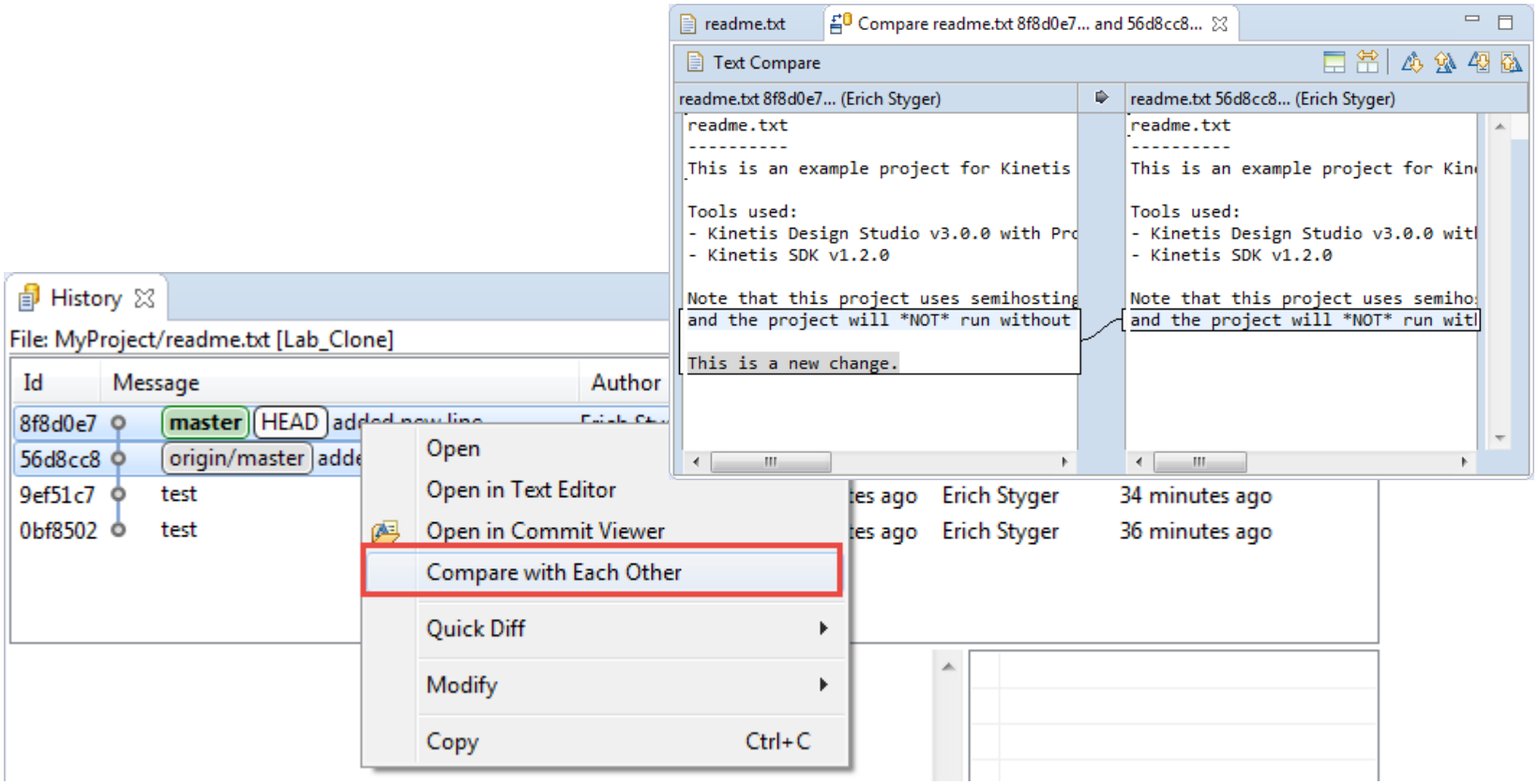






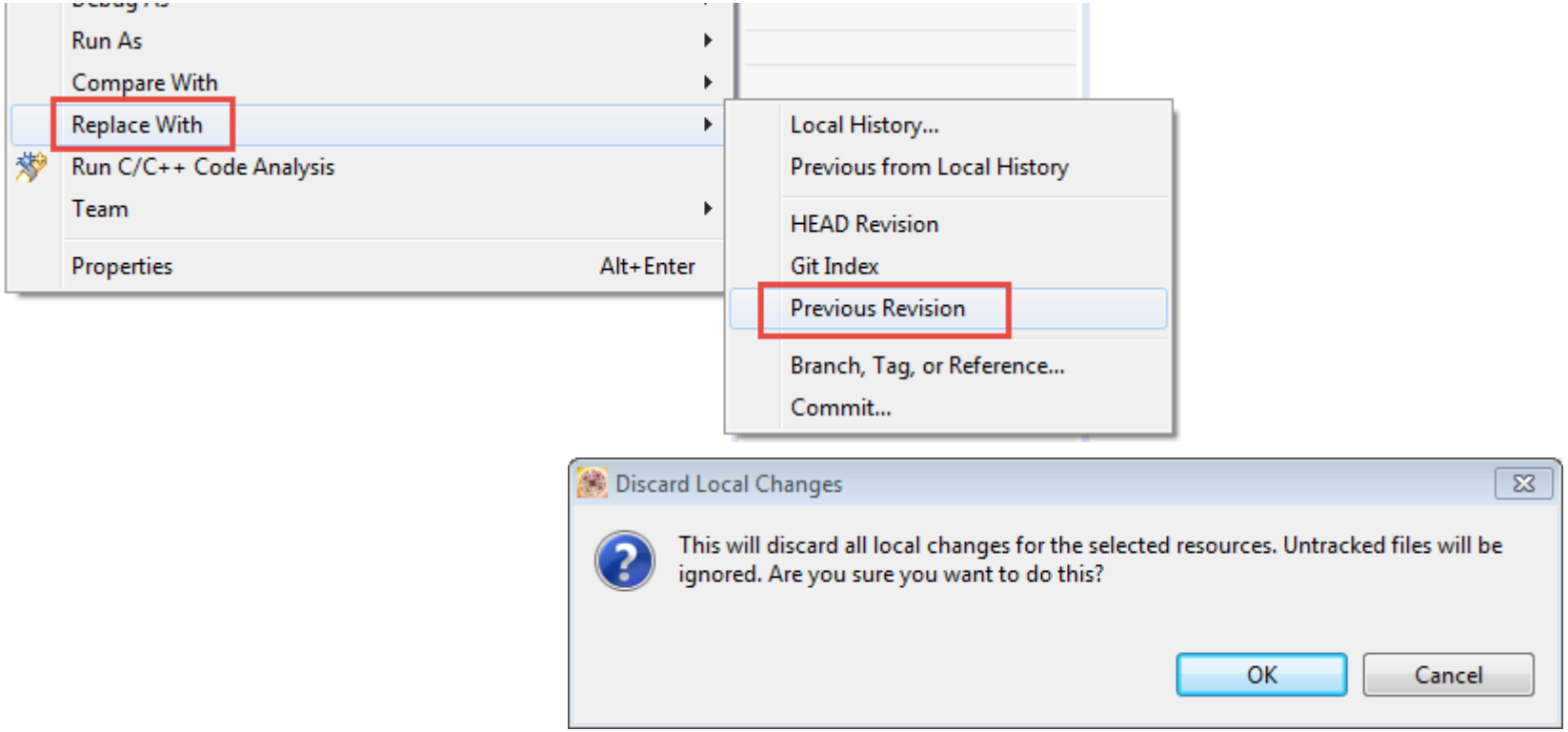
Compare

- Select two lines
- Context menu *Compare with Each Other*



Short Term Undo

- Select File
- Menu *Replace With > Previous Revision*



Summary

- Kinetis Design Studio IDE comes with version control built-in
- Understanding files in project
- Create Repository
- Add/Ignore/Change/Undo/Commit

- Further information:
  - http://mcuoneclipse.com/2013/03/29/version-control-with-processor-expert-projects/
  - http://mcuoneclipse.com/2013/08/13/installing-egit-in-eclipse-and-codewarrior-for-mcu10-4/
  - http://mcuoneclipse.com/2012/03/17/dissection-of-mcu10-projects/

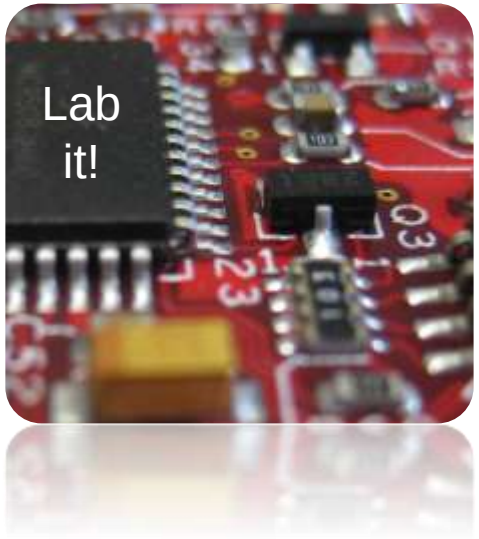
Build Automation

Why Build Automation

- Daily/Weekly/Monthly/etc automated builds
- In combination with version control system
  - Server checks out projects
  - Builds projects
  - Report errors/failures
- 'Continuous Integration' Process
- No graphical UI needed
  - Make files
  - Batch files
  - Scripting systems

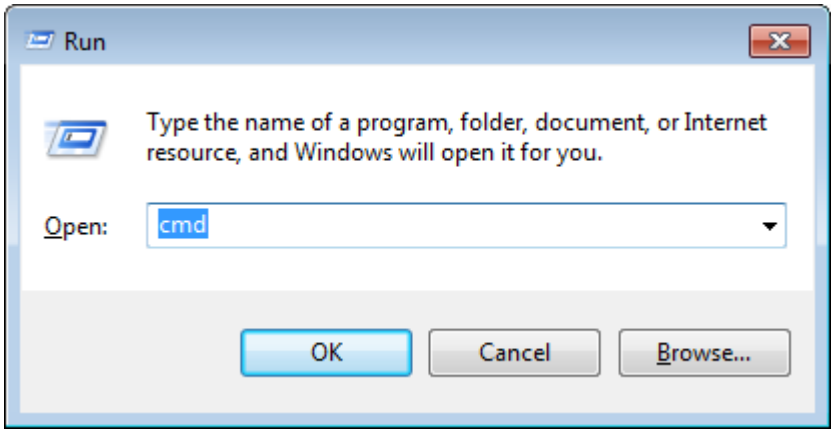
Build Automation: Lab Outline

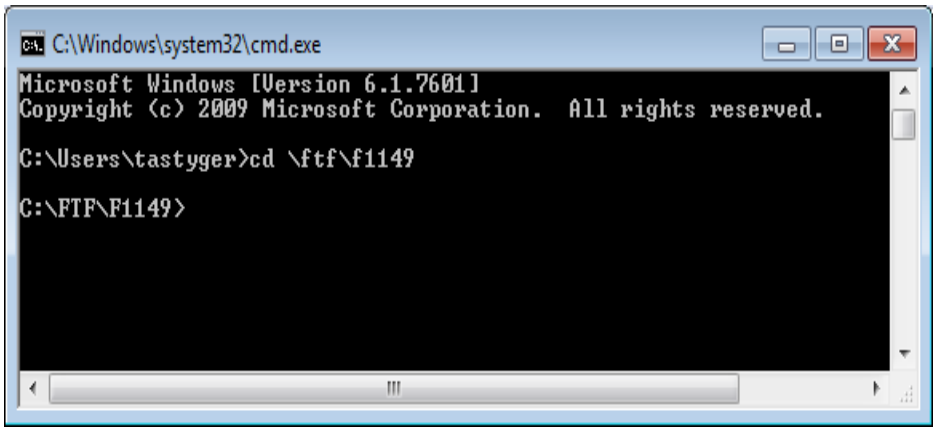
- Build automation with Eclipse projects
- Using headless version of Eclipse
  - Generating Processor Expert Code
  - Generating make files
  - Building project
- Building project with make outside of Eclipse



Windows Cmd.exe / DOS Shell

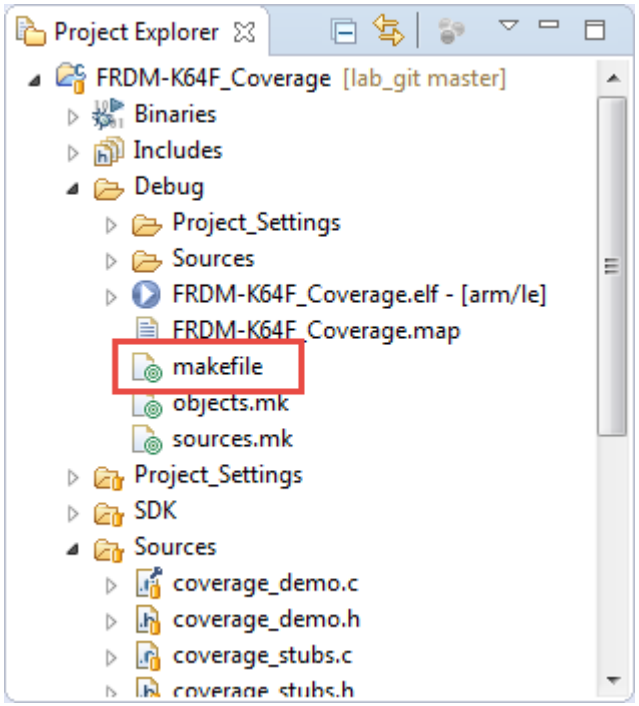
- Will use windows shell to run batch files in this lab
  - Simple
  - More sophisticated scripting: Python, TCL, Perl, Make Files, …
  - Principles applicable for other hosts (Mac OS, Linux)
- <Windows-R> (Run), then 'cmd' to open Cmd.exe
- **`cd \ftf\f1149`**





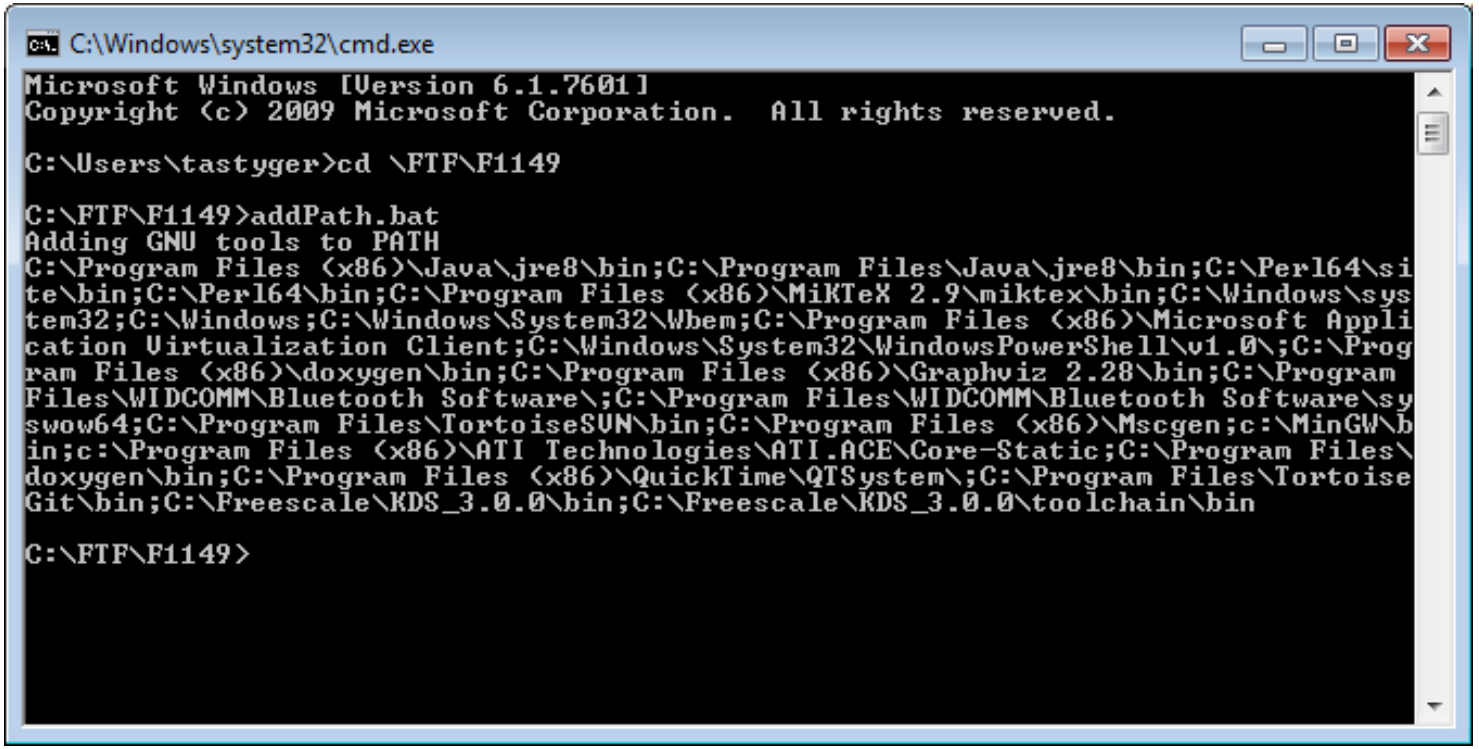
PATH Setup for Labs

- Eclipse build system uses make files
  - 'manual' make files
  - 'managed' make files (default in KDS)
- KDS v3.0.0 has make here:
  - C:\Freescale\KDS_3.0.0\bin
- Need to have GNU tools in PATH
  - C:\Freescale\KDS_3.0.0\toolchain\bin



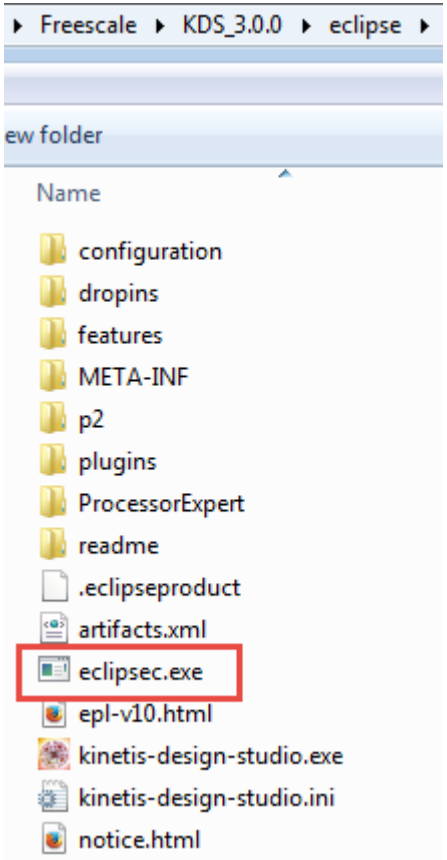
PATH Setup for Labs

- Run **`addPath.bat`**
- Extended PATH with
  `c:\Freescale\KDS_3.0.0\bin;`
  `c:\Freescale\KDS_3.0.0\toolchain\bin`



Building with Headless Eclipse

- Problem
  - Make files need to be generated
  - Generated files are usually not in version control system
- Solution
  - 'Headless' Build
  - Run Eclipse from the command line



Eclipse Command Line Mode: Import Project

- **Eclipsec:** command line version of Eclipse
- Command Line Options

  `-nosplash`: avoid splash screen

  `-launcher.suppressErrors`: no error

  `-application <plugin>`: plugin to run

  org.eclipse.cdt.managedbuilder.core.headlessbuild

  com.freescale.processorexpert.core.PExApplication

  `-import <project>`: import project into workspace

  `-data <wsp>`: workspace to use

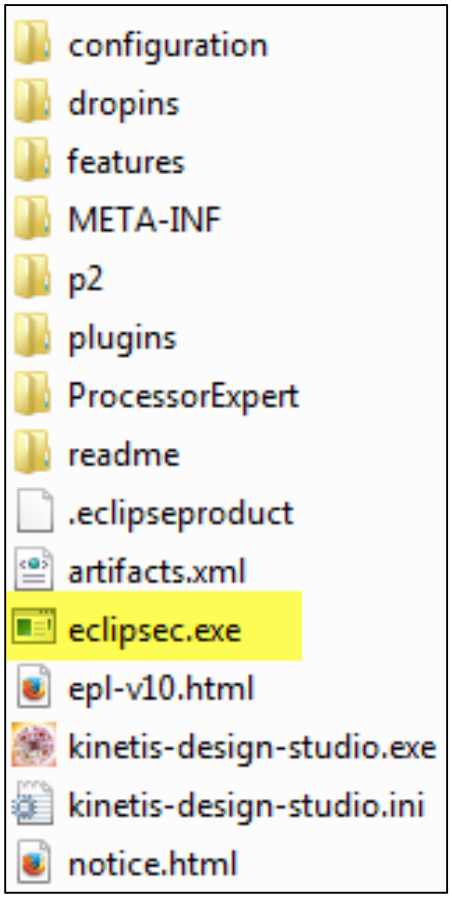
  Build:

  `-build <project>`: project to build

  `-cleanbuild all`: build all projects

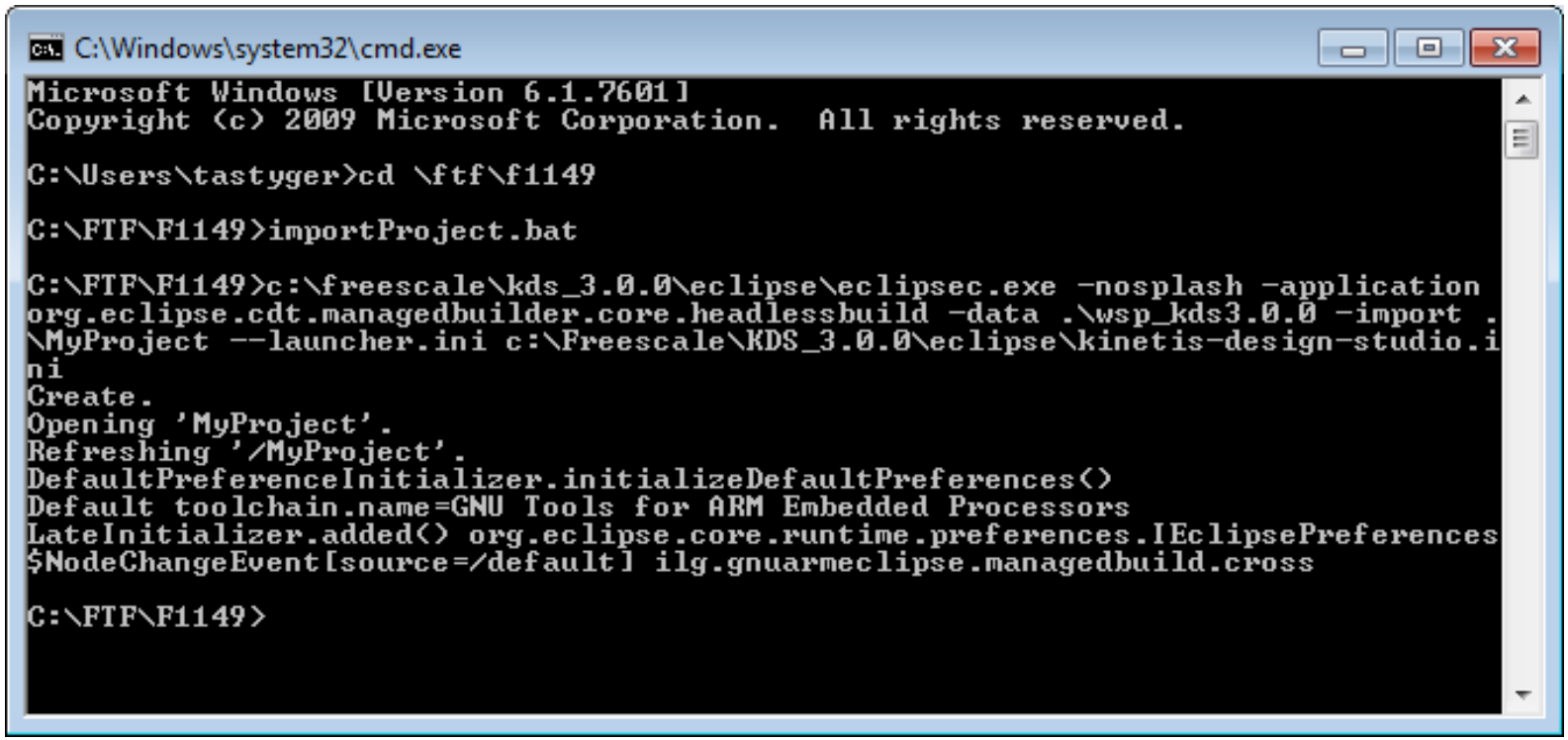
  `--launcher.ini <inifile>`: JRE, heap settings

  `--launcher.suppressErrors`: no error dialogs
- Options can be combined/use separately



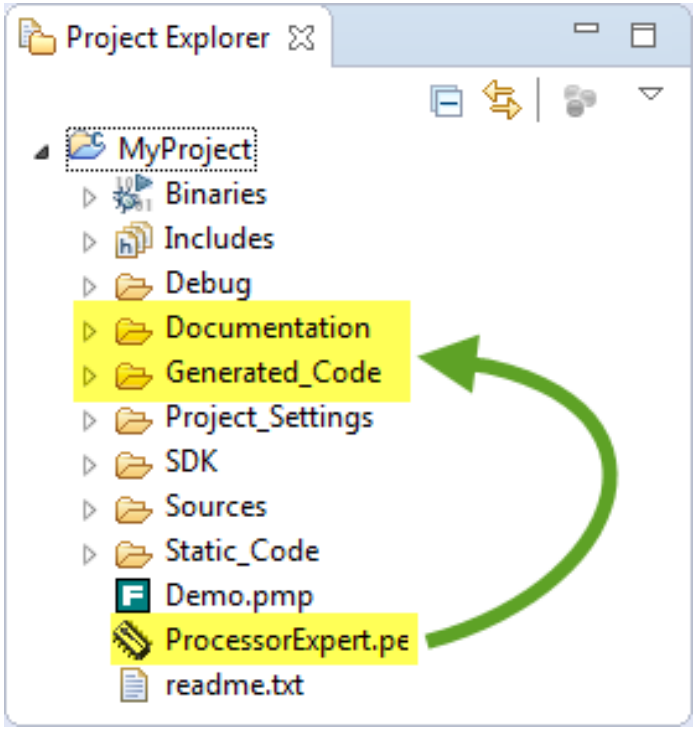
Importing Project

- Run **`importProject.bat`**
  - Creates workspace
  - Imports Project into workspace



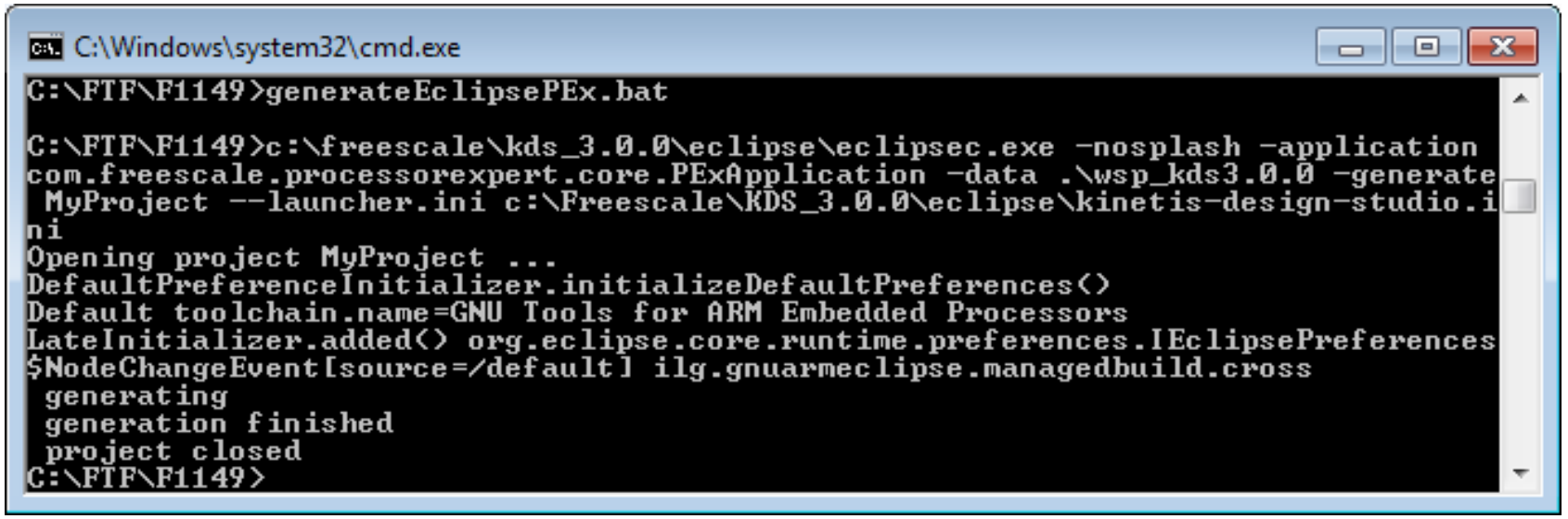
Processor Expert Projects and Eclipse

- Problem
  - Make files not present
  - If using Processor Expert: generates source code
  - Typically not stored in version control system
- Solution
  - Run Eclipse to generate Processor Expert code and to generate make files



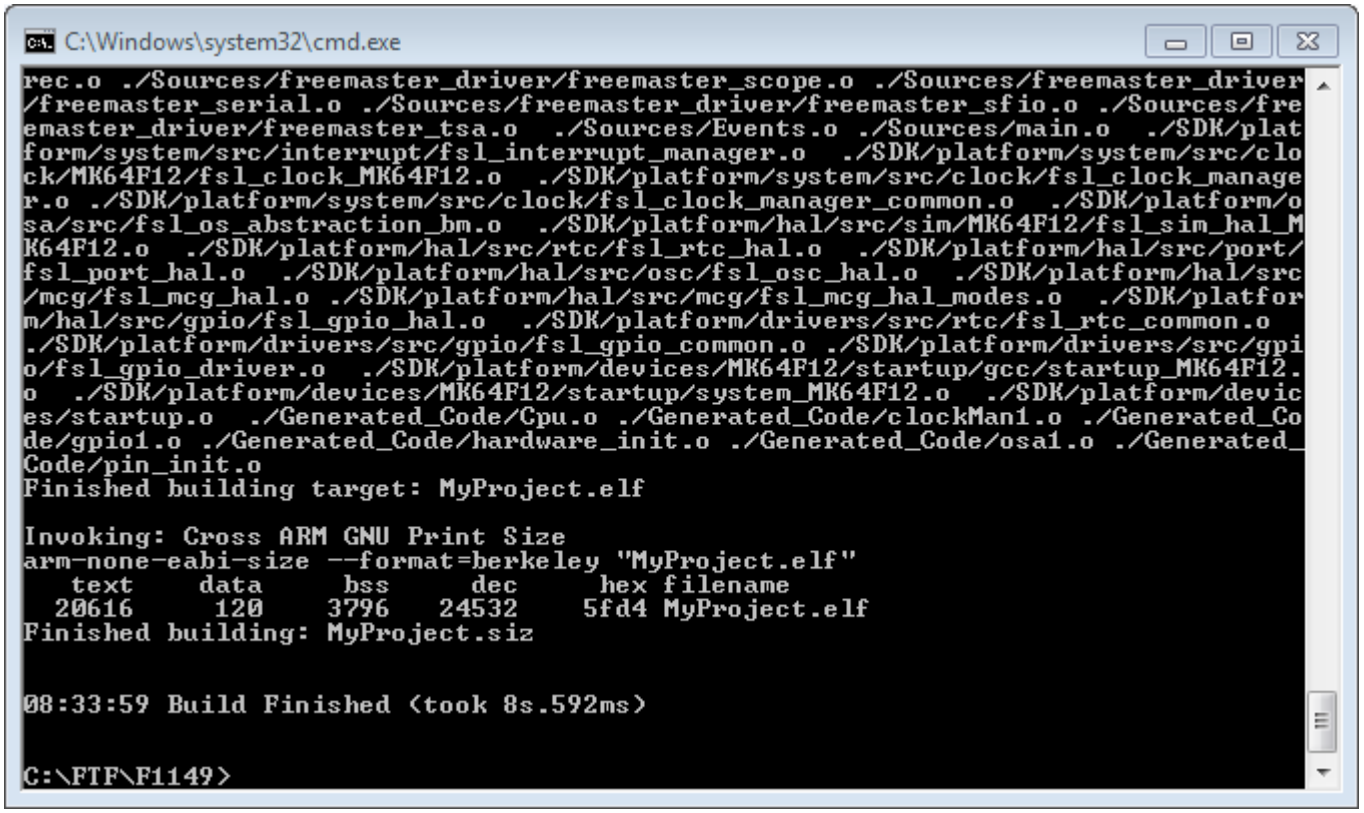
Generating Processor Expert Code

- Only required if using Processor Expert
- Run **`generateEclipsePEx.bat`**
  - Generates Processor Expert code



Build Project with Eclipse ➔ Make

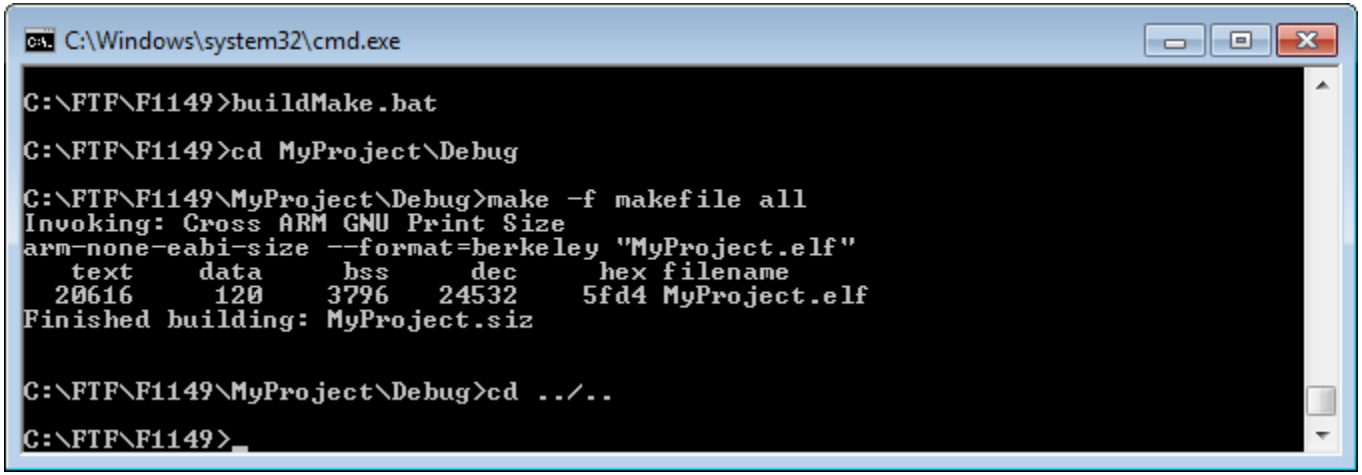
- Run **`buildEclipse.bat`**
  - Builds project



Build Project with Make

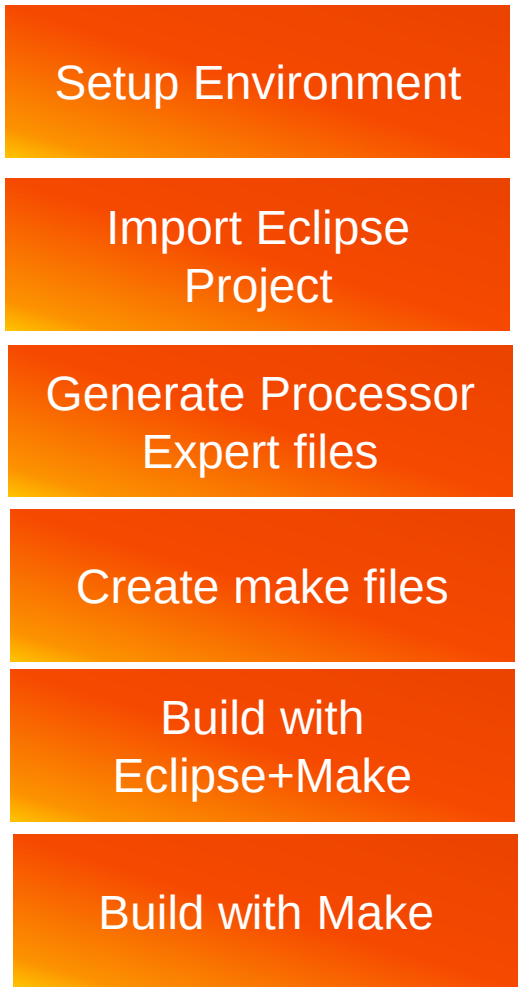
- `Make -f makefile all`
- Builds and links with managed make files (generated)
- Note: directory needs to be at make file level!
- Run **`buildMake.bat`**

```
cd MyProject\Debug
make -f makefile all
cd ../..
```



Overview

- Setup Environment
  - GNU Tools in PATH
  - addPath.bat
- Import Project into Workspace
  - Only if not already in workspace
  - importProject.bat
- Generate Processor Expert files
  - Only if Processor Expert Project
  - generateEclipsePEx.bat
- Build with Eclipse
  - Creates managed make files and builds
  - buildEclipse.bat
- Build with make (without Eclipse)
  - Only if make files exist
  - buildMake.bat



Summary

- Building Eclipse projects from the command line
- PATH to make/GNU tools
- Cmd.exe, Make.exe
- Make files need to be created/present
- Generating Processor Expert code
- Building with Eclipse
- Building with Make

- Further information:
  - http://mcuoneclipse.com/2014/09/12/building-projects-with-eclipse-from-the-command-line/
  - http://mcuoneclipse.com/2013/10/26/eclipse-command-line-code-generation-with-processor-expert/
  - http://help.eclipse.org/luna/index.jsp?topic=%2Forg.eclipse.platform.doc.isv%2Freference%2Fmisc%2Fruntime-options.html

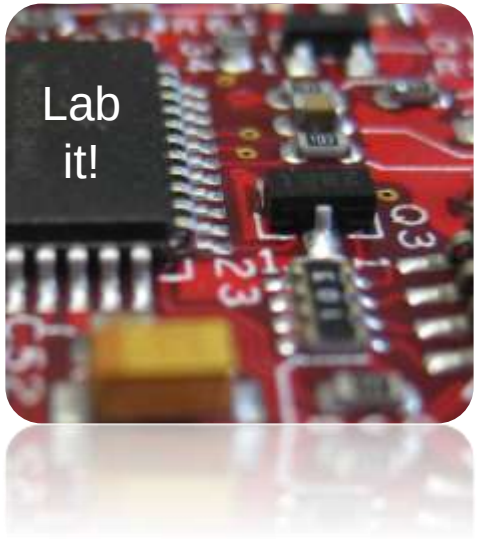
Debug Automation

Why Debug Automation

- Daily/Weekly/Monthly/etc automated builds with debug
- In combination with version control system
  - Server checks out projects
  - Builds projects
  - Runs it on hardware
- 'Continuous Integration and Debug' Process
- Hardware/Test Farm
- No graphical UI needed
  - Make files
  - Batch files
  - Scripting systems

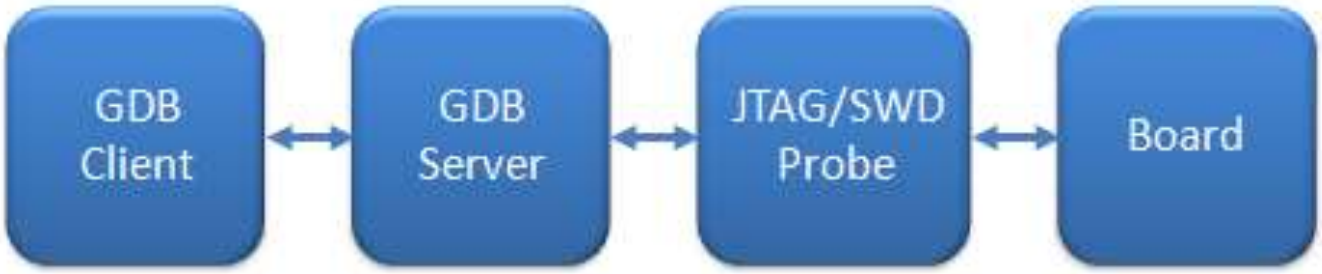
Debug Automation: Lab Outline

- Debug Eclipse projects without Eclipse
  - Command line GDB
- Exploring GDB
  - Running server/client
  - Load and debug application
- Automate debug session
  - Script file
  - Load and run application on board



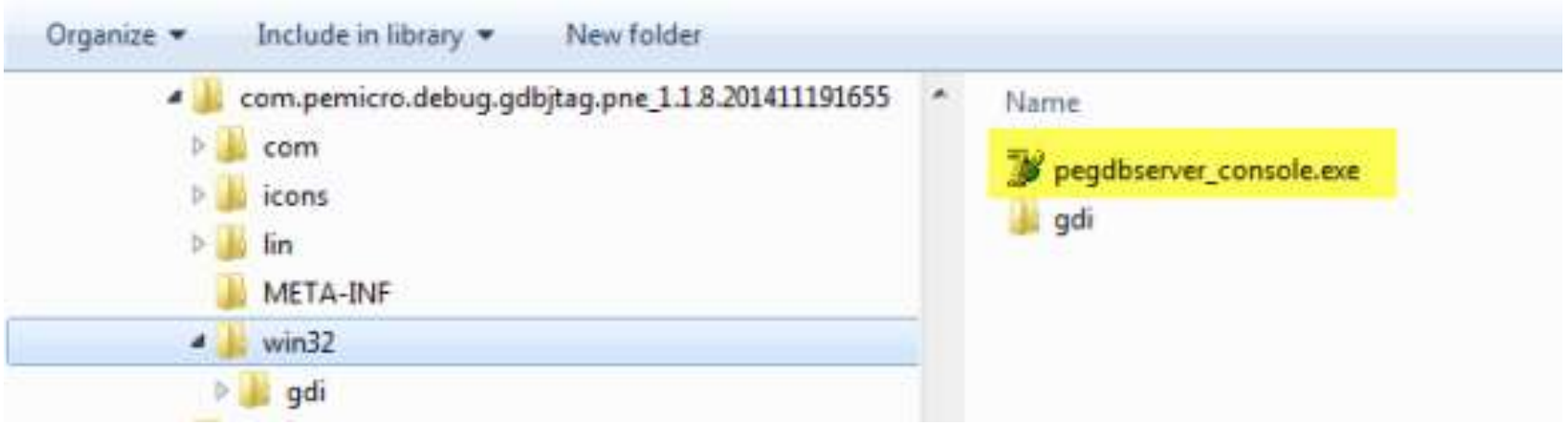
GDB Debugging

- GDB Client: communicates with server
  - arm-eabi-none-gdb.exe
- GDB Server: translates client commands into debug probe commands
  - P&E, Segger, OpenOCD, …
- JTAG/SWD Probe
  - Segger J-Link, P&E Multilink, …
- Board
  - FRDM-KL64F, FRDM-KL25Z, …



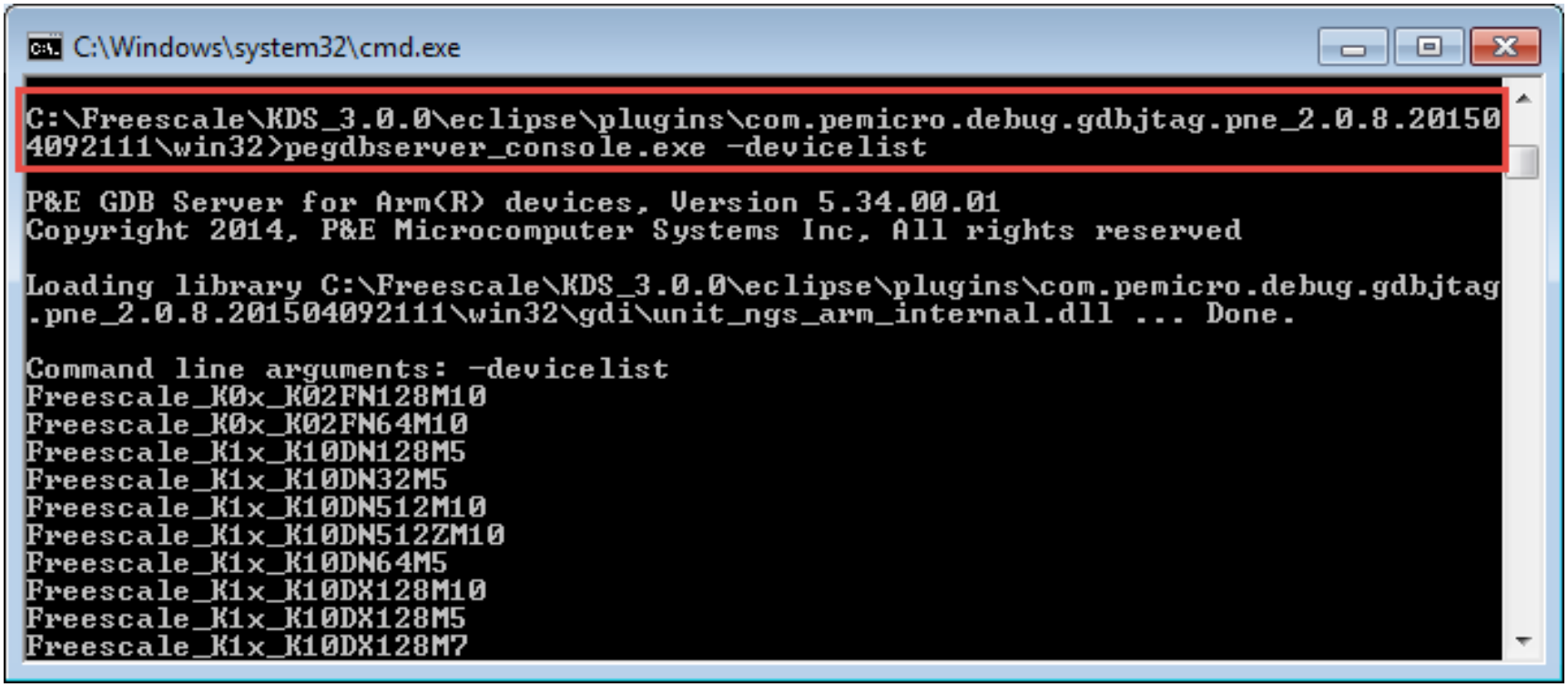
P&E GDB Server

- C:\Freescale\KDS_3.0.0\eclipse\plugins\com.pemicro.debug.gdbjtag.pne_2.0.8.201504092111\win32\pegdbserver_console.exe
- Command Line Arguments
  - **-startserver**: starts the server
  - **-device**: specifies the device
  - **-devicelist**: lists the supported devices



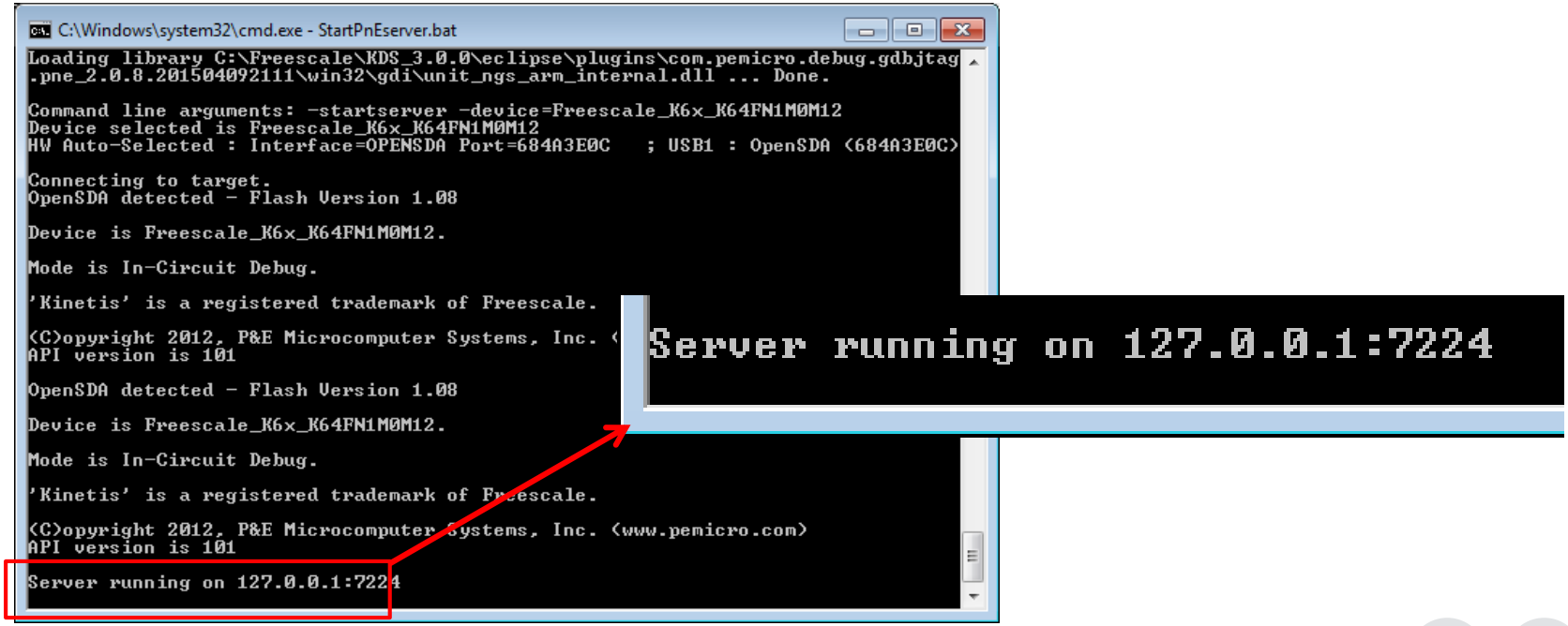
P&E GDB Server: Getting Device List

- `pegdbserver_console.exe -devicelist`



Start P&E GDB Server – Server stays running

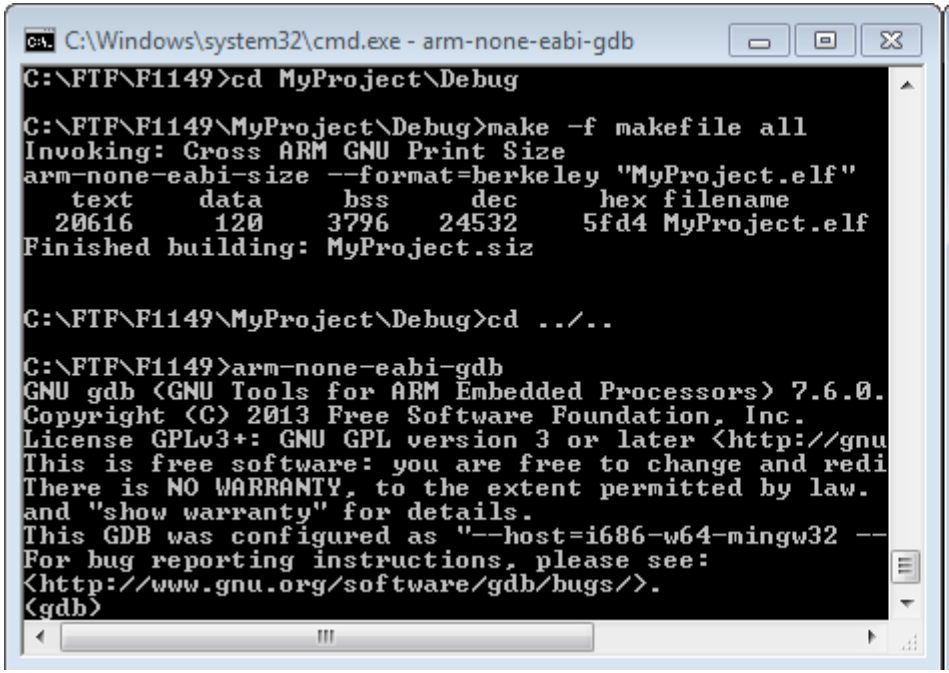
- Have Board with P&E OpenSDA firmware plugged in
- Start new **cmd.exe**, cd to \FTF\F1149
- Run **gdbStartServerPnE.bat**
- Keep Server running!! It is using `localhost:7224`



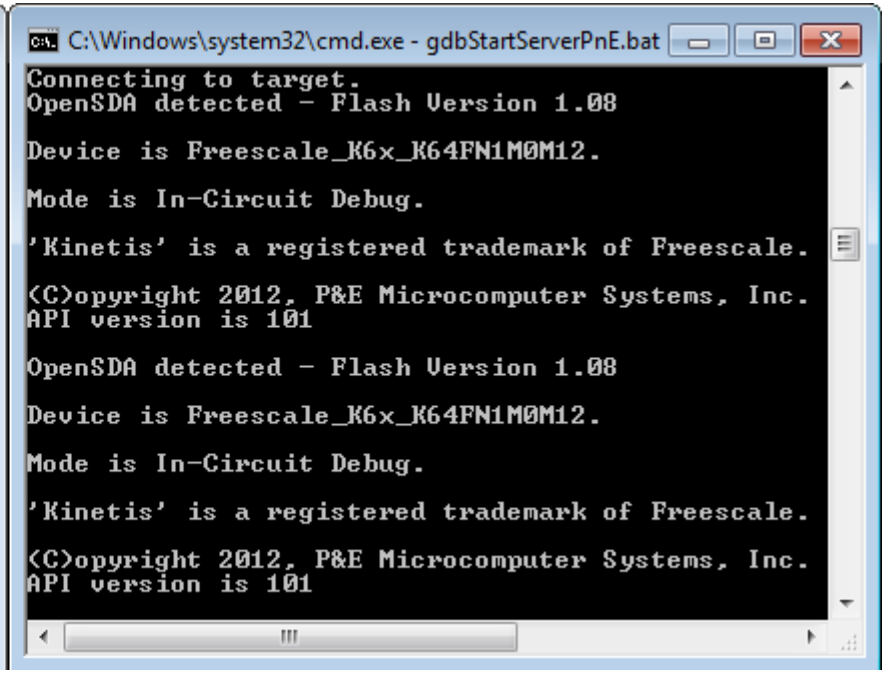
Starting GDB Client

- Run **arm-none-eabi-gdb**
- GDB prompt: (gdb)
- Client and Server not connected (yet)

GDB Client:



GDB Server (P&E):



GDB Client: Connect and Reset

- Connect to P&E GDB server
  - (gdb) **target remote localhost:7224**

```
(gdb) target remote localhost:7224
Remote debugging using localhost:7224
0x000004d8 in ?? ()
```

```
Server running on 127.0.0.1:7224
Connection from "127.0.0.1" via 127.0.0.1
```

- Reset target
  - (gdb) **monitor reset**

```
(gdb) monitor reset
Command Executed successfully: reset
```

```
Server running on 127.0.0.1:7224
Connection from "127.0.0.1" via 127.0.0.1
CPU reset by debugger.
```

GDB Client: Load

- Load Application File
  - (gdb) **load <elf file name>**
  - NOTE: use forward (/) slashes for path!

```
(gdb) load MyProject/Debug/MyProject.elf
Loading section .interrupts, size 0x400 lma 0x0
Loading section .flash_config, size 0x10 lma 0x400
Loading section .text, size 0x4c70 lma 0x410
Loading section .ARM, size 0x8 lma 0x5080
Loading section .init_array, size 0x4 lma 0x5088
Loading section .fini_array, size 0x4 lma 0x508c
Loading section .data, size 0x70 lma 0x5090
Start address 0x4d8, load size 20736
Transfer rate: 5 KB/sec, 864 bytes/write.
(gdb)
```

```
CMD>RE


Initializing.
Target has been RESET and is active.
```

- Load Debug Symbols
  - (gdb) **file <elf file name>**
  - Use 'y' to load file if already debugged

```
(gdb) file MyProject/Debug/MyProject.elf
A program is being debugged already.
Are you sure you want to change the file? (y or n) y
Reading symbols from C:\FTF\F1149\MyProject\Debug\MyProject.elf...done.
(gdb)
```

GDB Client: Run

- Stepping
  - (gdb) **step**

```
(gdb) step
328             bl SystemInit
(gdb) _
```

- Run application
  - (gdb) **continue**

```
(gdb) continue
Continuing.
```

- Stop application
  - **CTRL+C** will stop it

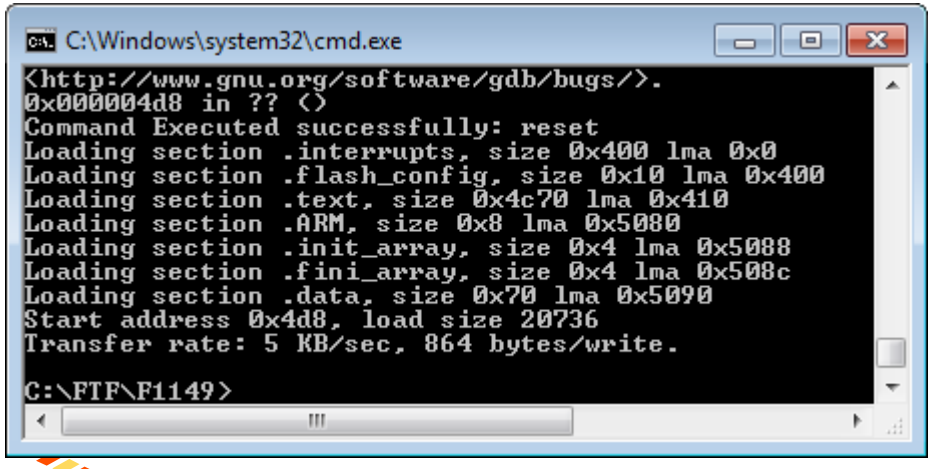
```
Program received signal SIGINT, Interrupt.
0x000038d2 in OSA_TimeGetMsec () at ../Generated_Code/osa1.c:143
143     }
(gdb) _
```

- Quit/terminate GDB
- (gdb) **quit**

```
(gdb) quit
A debugging session is active.

        Inferior 1 [Remote target] will be killed.

Quit anyway? (y or n) y

C:\FTF\F1149>
```

GDB Debug Automation

- Run everything from single batch file
  - Start GDB server (option `-singlesession`)
  - Run gdb with script file (option `-x`)
- Script File
  - `Set confirm off`: disable confirmation question
  - `Detach`: detach from target and run it
- Close/Terminate running Server
- Run **`gdbRun.bat`**




```
set confirm off
target remote localhost:7224
monitor reset
file MyProject/Debug/MyProject.elf
load MyProject/Debug/MyProject.elf
detach
quit
```

Summary

- GDB Client and GDB Server
- Command line debugging with GDB
- Scripting GDB debug session

- Further information:
  - http://mcuoneclipse.com/2015/03/25/command-line-programming-and-debugging-with-gdb/
  - https://cs.brown.edu/courses/cs033/docs/guides/gdb.pdf

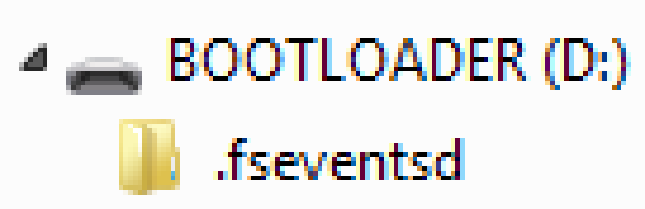
Coverage

What is Coverage?

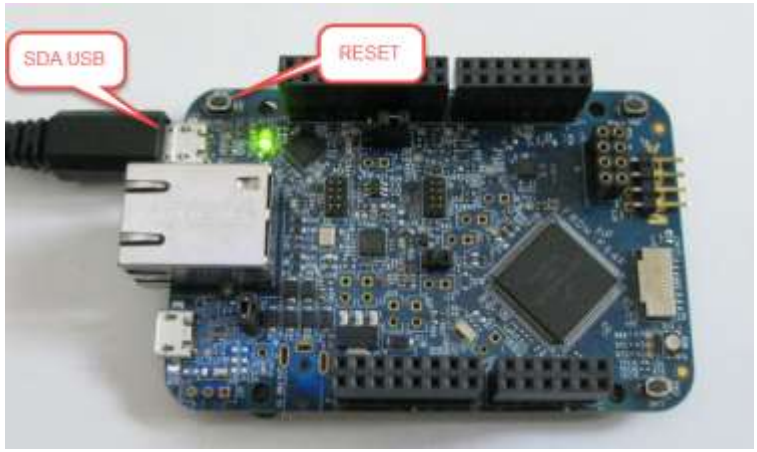
- Information about
  - Which parts have been executed in the code
  - How many times
- Test Coverage

Lab Setup: Segger FRDM-K64F OpenSDA Firmware

- Power Board with 'SDA USB' while RESET button pressed
  - Green LED near connector blinks slowly
  - Board enumerates as BOOTLOADER
  - Copy firmware file (**JLink_OpenSDA_V2_2015-04-23.bin**) to BOOTLOADER drive
  - Green LED blinks fast
- Repower board with SDA USB port normally
  - USB driver might enumerate
  - Green LED is on

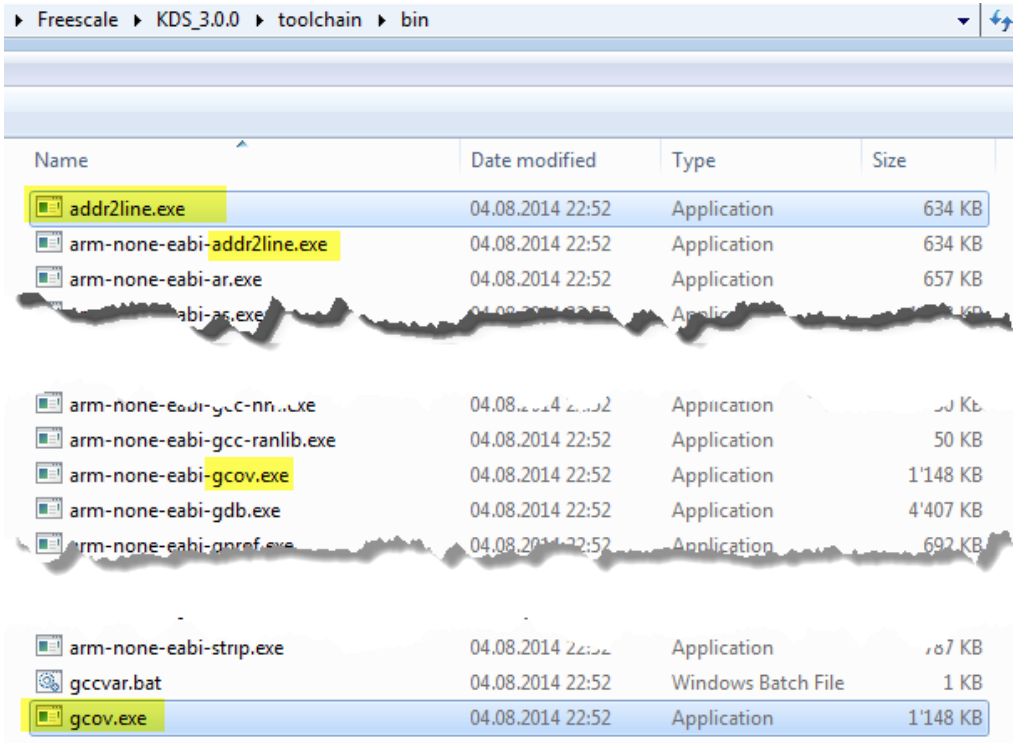


File I/O
Semihosting



Lab Setup: Gcov Binaries Dependency

- GNU binaries in C:\Freescale\KDS_3.0.0\toolchain\bin
- Have copies of needed GNU binaries without 'arm-none-eabi'
- Run **`checkGNUbin.bat`**
  - Copy of files with new names (without arm-none-eabi)



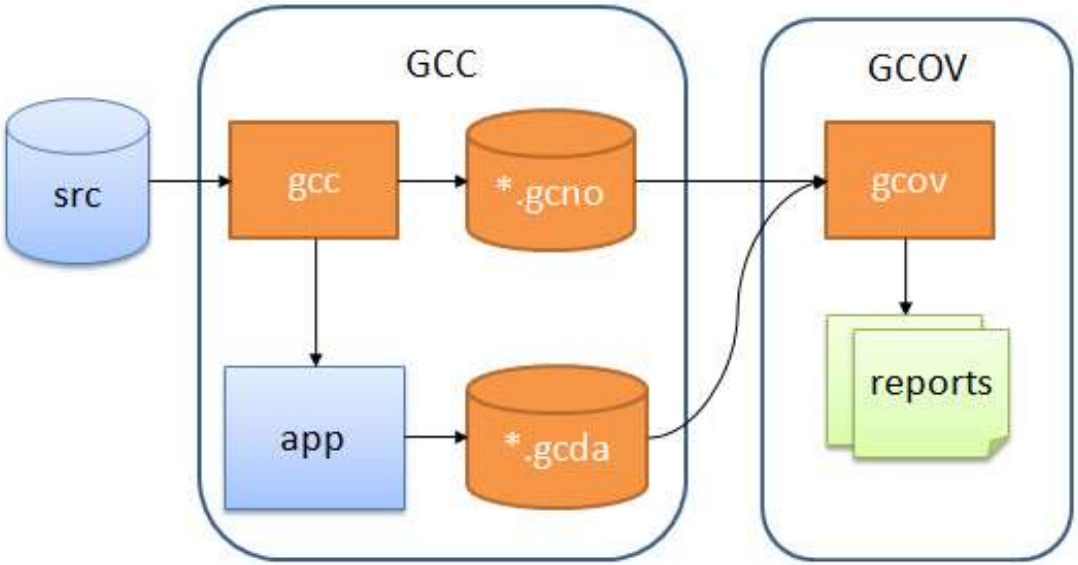
Lab Setup: Launch Eclipse

- Command Prompt (<Windows>+R, then cmd)
- Change director to c:\ftf\f1149
- Run **`runEclipseGcov.bat`**
  - Ensures GNU tools in PATH
  - Ensures proper names of GNU tools
  - Launches Kinetis Design Studio with workspace specified

```
REM Run Eclipse with gcov environment

REM Check that path setup is correct
call addPath.bat

REM Check that GNU tools are present
call checkGNUbin.bat

REM launch Eclipse
C:\Freescale\KDS_3.0.0\eclipse\kinetis-design-studio.exe -data .\wsp_kds3.0.0
```

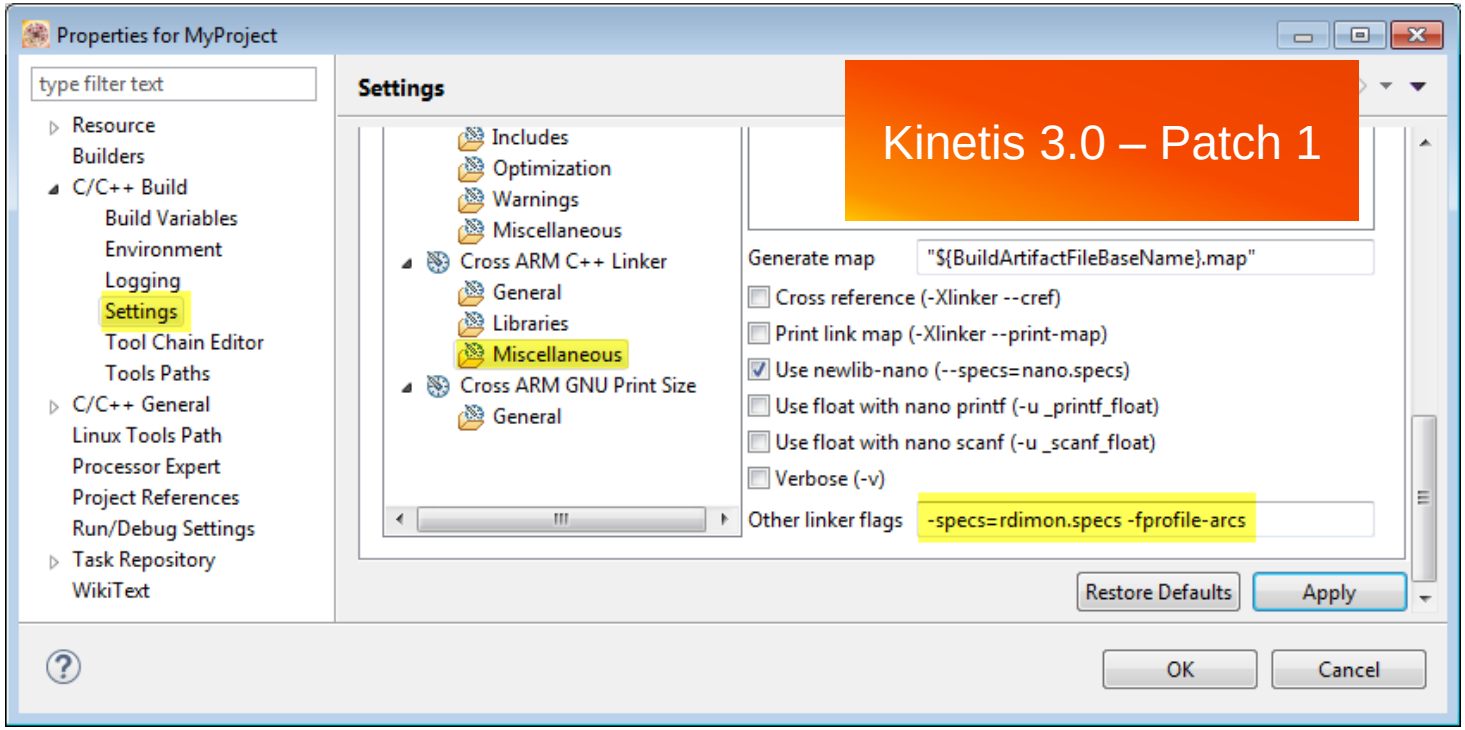
Overview: Coverage with GNU Tools

- Instrumentation of application with gcc
  - Generates .gcno (GNU Coverage Node) information
- Run the application on target
  - Generates .gcda (Gnu Coverage Data) file
- Show coverage information on host with gcov



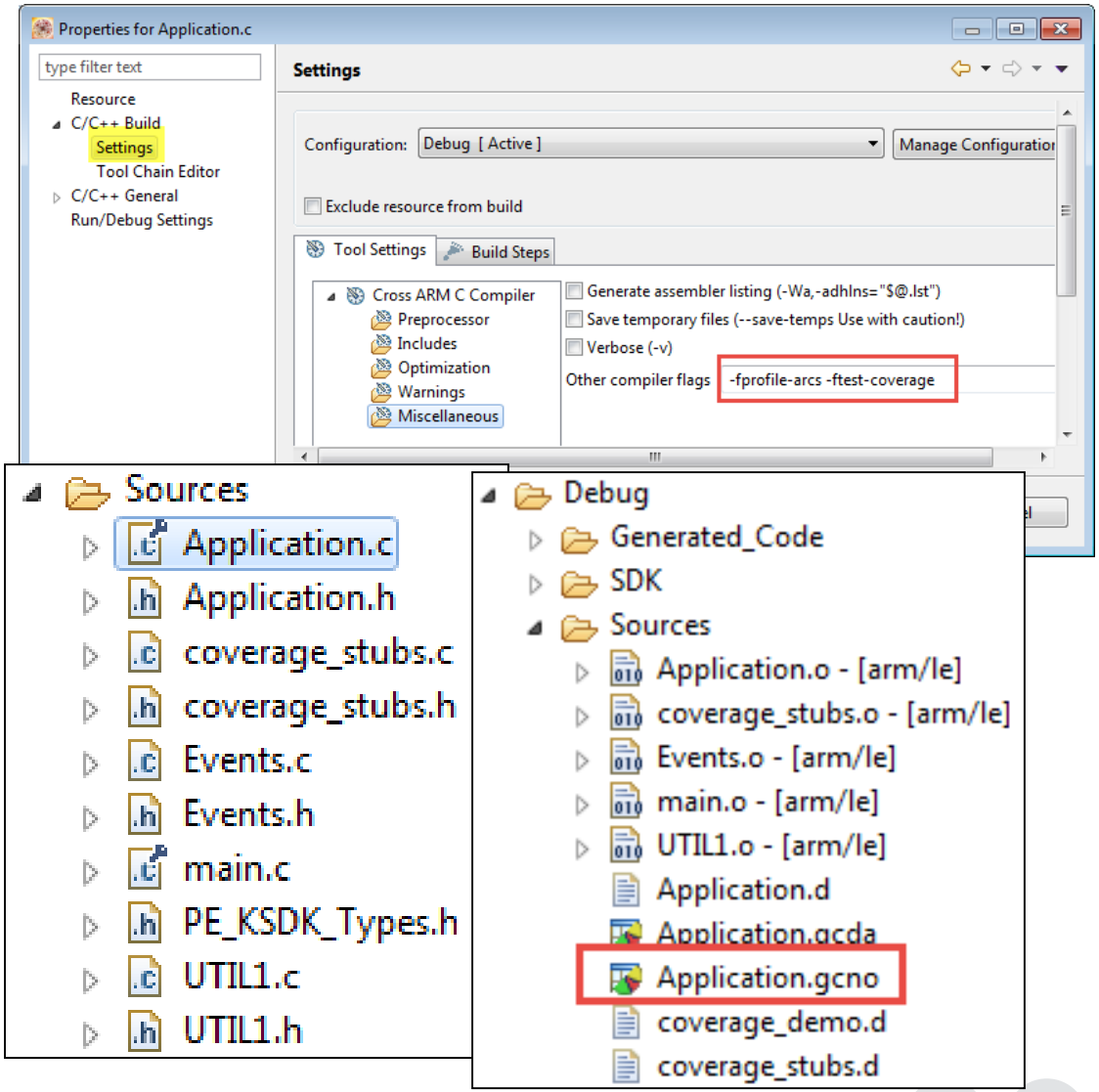
Instrumentation: Linker Project Option

- Project Properties
- Miscellaneous Linker Settings
  - `-specs=rdimon.specs`: Use semihosting (file/console I/O)
  - `-fprofile-arcs`: Use profiling/instrumentation



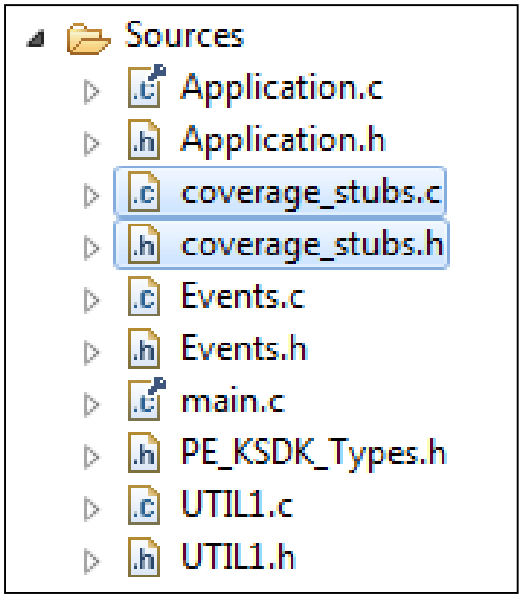
Instrumentation Compiler Option

- Instrument few files, less overhead/RAM needed
- Right click on file to instrument
- 'Pinned' mode
- Compiler options
  `-fprofile-arcs`
  `-ftest-coverage`
- Will create ***.gcno** file



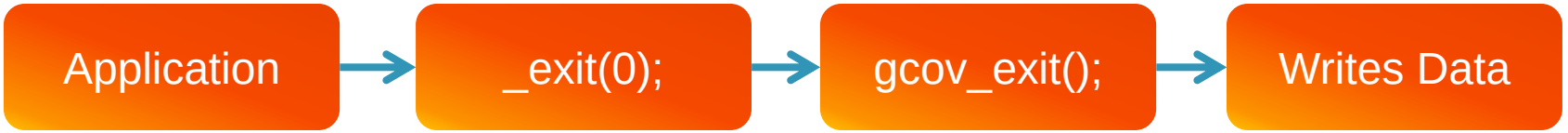
Coverage Stubs

- Set of coverage support routines
  - _exit(), _write(), _open(), _close(), …
- Coverage will write 'file' with data
  - Can intercept _write() to dump data with gdb to file (See Backup material)
  - Using **semihosting** to write data
    - `COV_USE_SEMIHOSTING` macro enabled in coverage_stubs.h



Coverage Information Written at Exit

- Application to call `_exit()`
- Coverage data appended to existing data files



Application.c

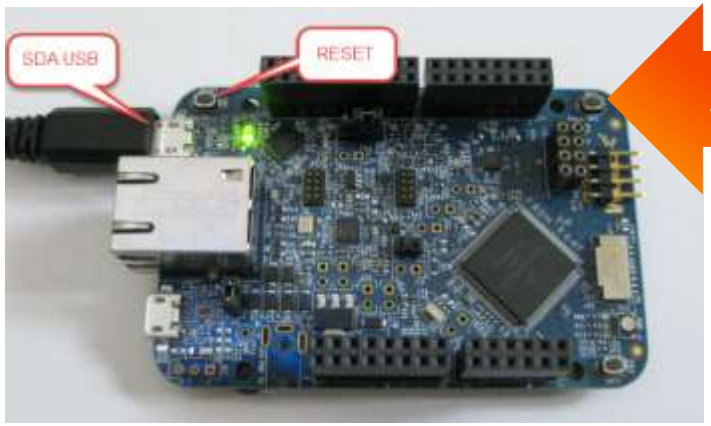
```
void APP_Run(void) {
  printf("Lab program using semihosting!\r\nProgram will NOT
  for(;;) {
    CheckButton();
    if (whichLED==LED_COLOR_RED) {
      GPIO_DRV_TogglePinOutput(led_red); /* red toggle */
    }
    if (whichLED==LED_COLOR_GREEN) {
      GPIO_DRV_TogglePinOutput(led_green); /* green toggle *
    }
    if (whichLED==LED_COLOR_BLUE) {
      GPIO_DRV_TogglePinOutput(led_blue); /* blue toggle */
    }
    OSA_TimeDelay(100); /* wait 100 ms */
    doExit = nofButtonPresses>5;
    if (doExit) {
      _exit(0); /* write coverage information */
    }
  }
}
```

coverage_stubs.c

```
void _exit(int status) {
  void gcov_exit(void); /* prototype */

  (void) status;
  gcov_exit(); /* call coverage exit routine */
  /* turn on all LED's ==> WHITE */
  GPIO_DRV_ClearPinOutput(led_red);
  GPIO_DRV_ClearPinOutput(led_green);
  GPIO_DRV_ClearPinOutput(led_blue);
  for(;;){} /* does not return */
}

#endif /* COV_DO_COVERAGE */
```

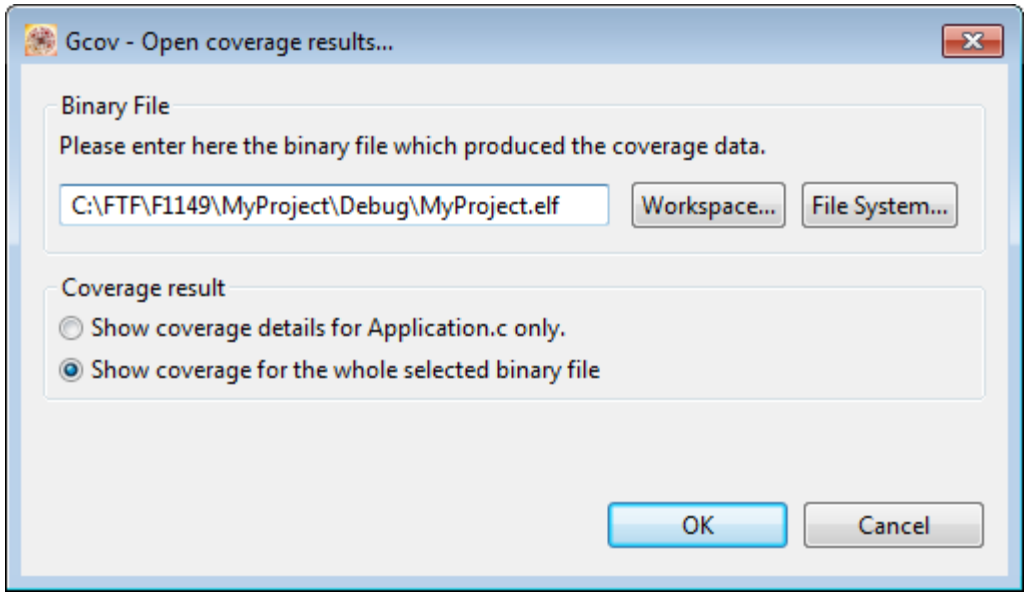
Lab: First Coverage Run

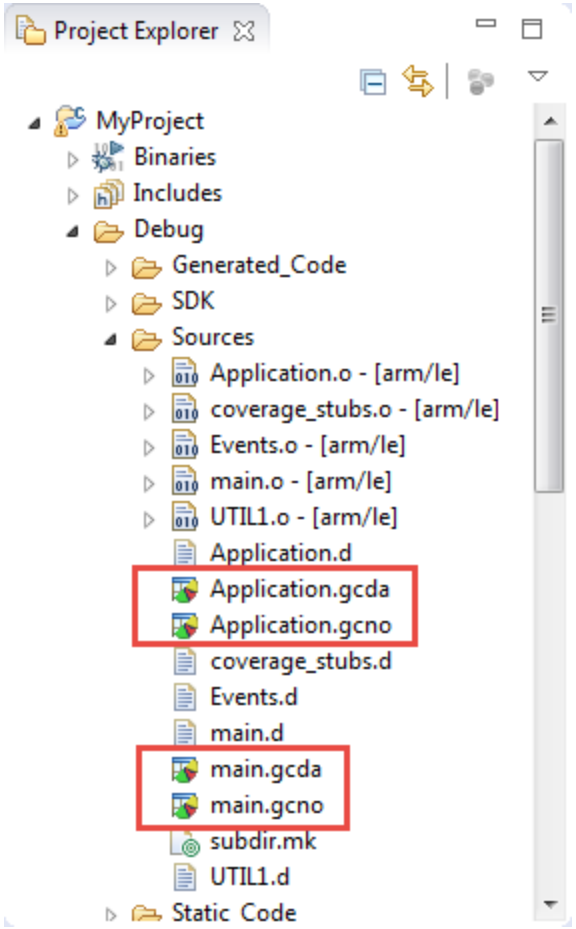
- Clean: delete 'Debug' folder in project
- Build application
- Debug application with **Segger**
- Run application
  - RED LED is blinking
- Press SW2
  - LED color changes
- After >5 SW2 presses
  - LED turned off
  - _exit() called by application
  - Trace dump written host
  - LED turns white after ~60 seconds
- Terminate debug session



Open Data with Gcov

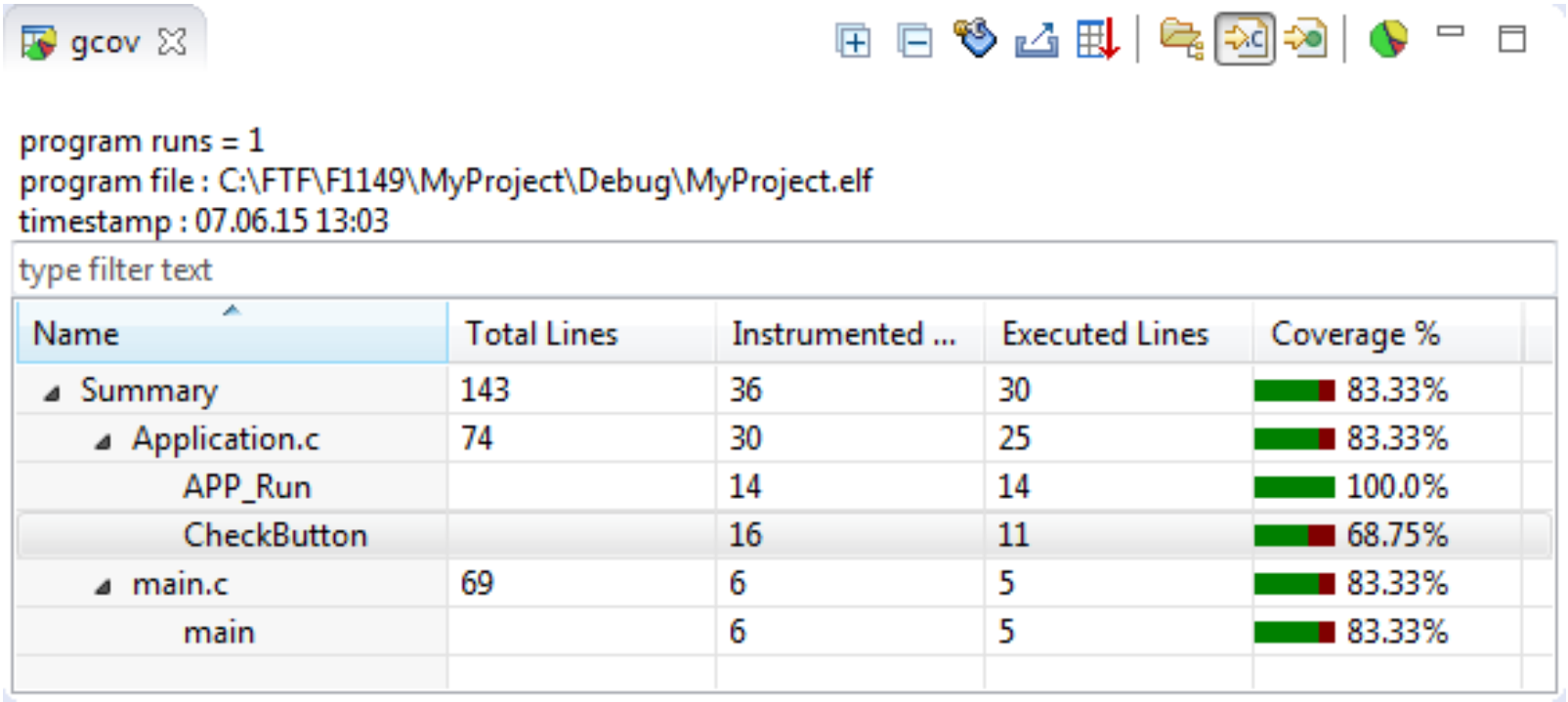
- Double-Click on any coverage file
  - Context menu Refresh
- Opens Dialog
- Specify application .elf file
- Press OK





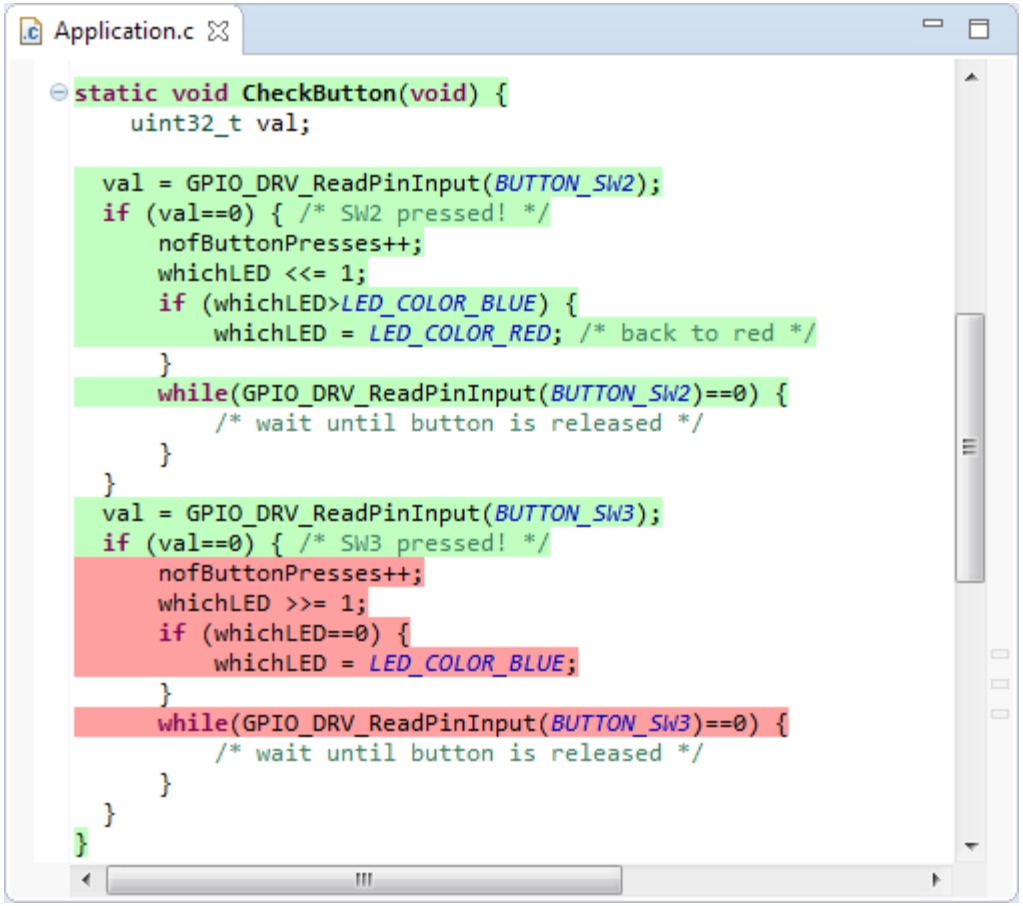
Gcov Eclipse View

- Gcov view showing status of coverage
  - summary, modules, functions
- Double-click on File/function to show details
  - Opens Source view



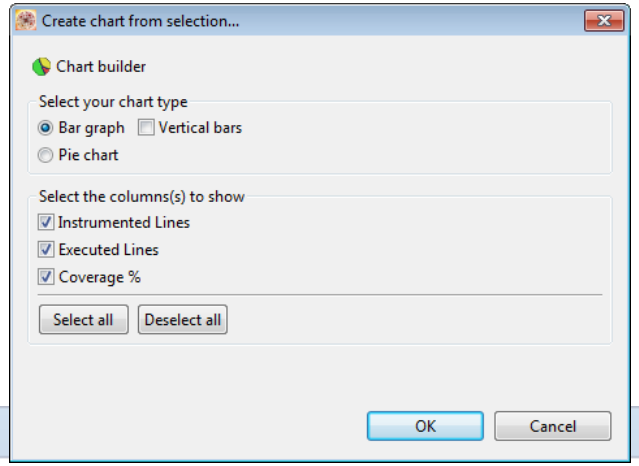
Coverage Information in Source View

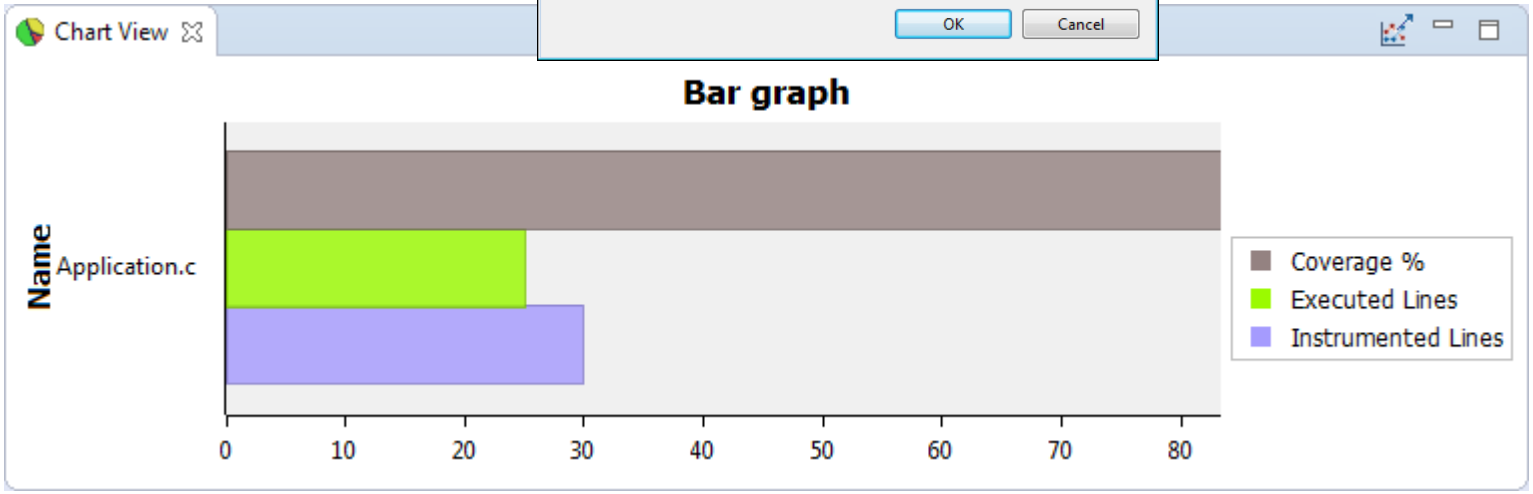
- Green: executed/covered
- Red: not covered
- As only used SW2:
  - Code for SW3 not handled



gcov Chart View

- Use 'chart' icon to open chart view
- Can save/export data in different formats





Multiple Coverage Runs

- Can run multiple test scenarios/coverage runs
- Gcov library will append information to files
  - Semihosting easily supports this ☺
- Run multiple sessions
  - This time, use SW3
  - Coverage should reach 100% ☺

gcov

program runs = 2
program file : C:\FTF\...1149\MyProject\Debug\MyProject.elf
timestamp : 07.06.15 13:12

type filter text

Name	Total Lines	Instrumented ...	Executed Lines	Coverage %
Summary	143	36	35	97.22%
Application.c	74	30	30	100.0%
APP_Run		14	14	100.0%
CheckButton		16	16	100.0%
main.c	69	6	5	83.33%
main		6	5	83.33%

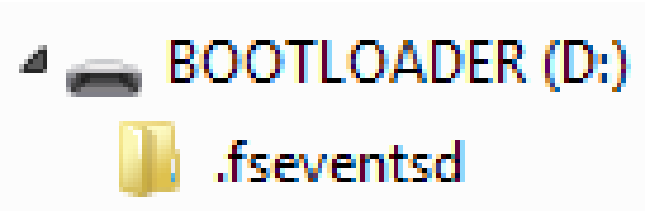
Summary

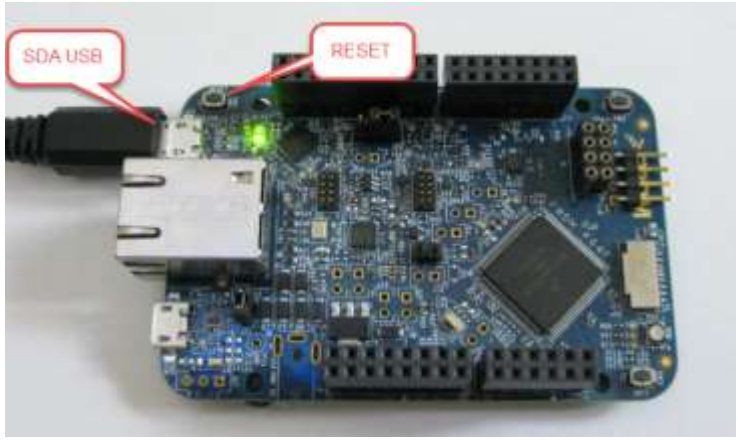
- Coverage for test coverage verification
- Generate Coverage information
  - Instrument code
  - Generate Instrumentation Information
  - Run and collect information
  - Analyze results with gcov
- Dump Coverage Information
  - Debugger file dump: not very user friendly
  - Semihosting: only with debugger attached, not very fast
  - Other options: SD card, custom communication channel, …

- Further information:
  - http://mcuoneclipse.com/2014/12/26/code-coverage-for-embedded-target-with-eclipse-gcc-and-gcov/
  - http://mcuoneclipse.com/2015/05/31/code-coverage-with-gcov-launchpad-tools-and-eclipse-kinetis-design-studio-v3-0-0/
  - http://mcuoneclipse.com/2014/11/01/illustrated-step-by-step-instructions-updating-the-freescale-freedom-board-firmware/
  - http://mcuoneclipse.com/2014/06/06/semihosting-with-kinetis-design-studio/

WAIT! Load P&E FRDM-K64F OpenSDA Firmware

- Power Board with 'SDA USB' while RESET button pressed
  - Green LED near connector blinks slowly
  - Board enumerates as BOOTLOADER
  - Copy firmware file (**DEBUG-FRDM-K64F_Pemicro_v108a_for_OpenSDA_v2.0.bin**) to BOOTLOADER drive
  - Green LED blinks fast
- Repower board with SDA USB port normally
  - USB driver might enumerate
  - Green LED is on





Session Closing

What we have achieved…

Results

- Advanced Features with Kinetis Design Studio IDE
  - Version Control
  - Build automation
  - Debug automation
  - Code Coverage/Profiling

For Further Information

- Kinetis Design Studio IDE
  - www.freescale.com/kds
- Kinetis Software Development Kit (SDK)
  - www.freescale.com/ksdk
- FreeRTOS website
  - www.freertos.org
- Examples and Tutorials for Kinetis devices
  - www.mcuoneclipse.com
- Contact
  - Mark Ruthenbeck, mark.ruthenbeck@freescale.com
  - Prof. Erich Styger, erich.styger@freescale.com

www.Freescale.com

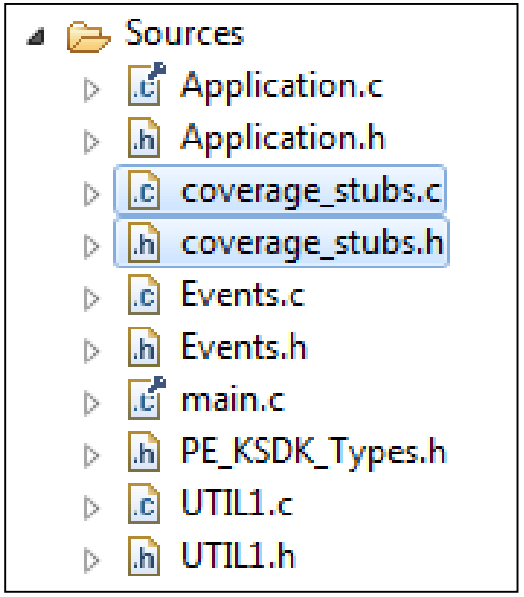
Backup Material

Dumping Coverage Data with GDB

Following material shows how to use GDB debugger commands to dump the coverage data to files on the host. This approach does not require semihosting. However, it does not allow combining multiple coverage runs without additional tools.

Coverage Stubs

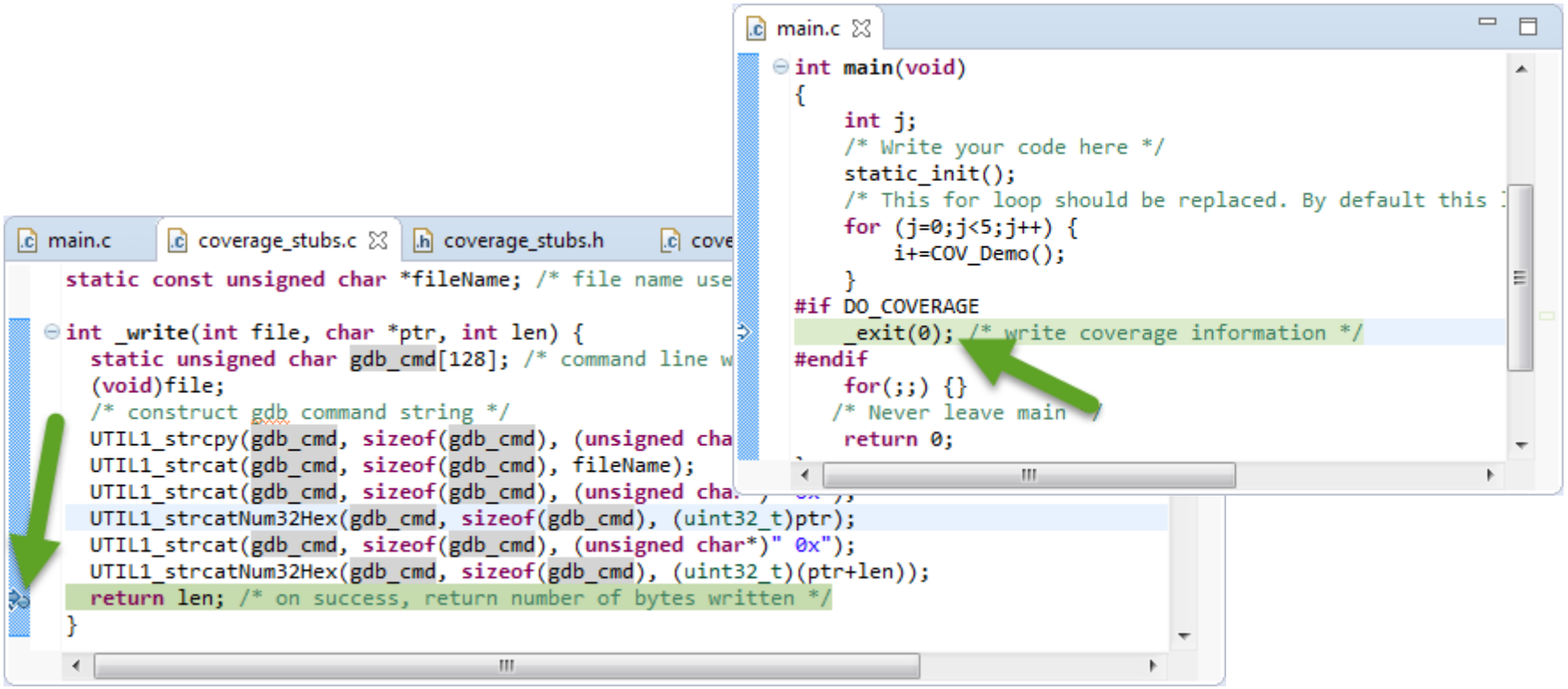
- Set of coverage support routines
  - _exit(), _write(), _open(), _close(), …
- Coverage will write 'file' with data
  - Use semihosting to write data
  - Can intercept _write() to dump data with gdb to file (See Backup material)




```
int _write(int file, char *ptr, int len) {
  static unsigned char gdb_cmd[128]; /* command line which can be used for gdb */
  (void)file;
  /* construct gdb command string */
  UTIL1_strcpy(gdb_cmd, sizeof(gdb_cmd), (unsigned char*)"dump binary memory ");
  UTIL1_strcat(gdb_cmd, sizeof(gdb_cmd), fileName);
  UTIL1_strcat(gdb_cmd, sizeof(gdb_cmd), (unsigned char*)" 0x");
  UTIL1_strcatNum32Hex(gdb_cmd, sizeof(gdb_cmd), (uint32_t)ptr);
  UTIL1_strcat(gdb_cmd, sizeof(gdb_cmd), (unsigned char*)" 0x");
  UTIL1_strcatNum32Hex(gdb_cmd, sizeof(gdb_cmd), (uint32_t)(ptr+len));
  return len; /* on success, return number of bytes written */
}
```

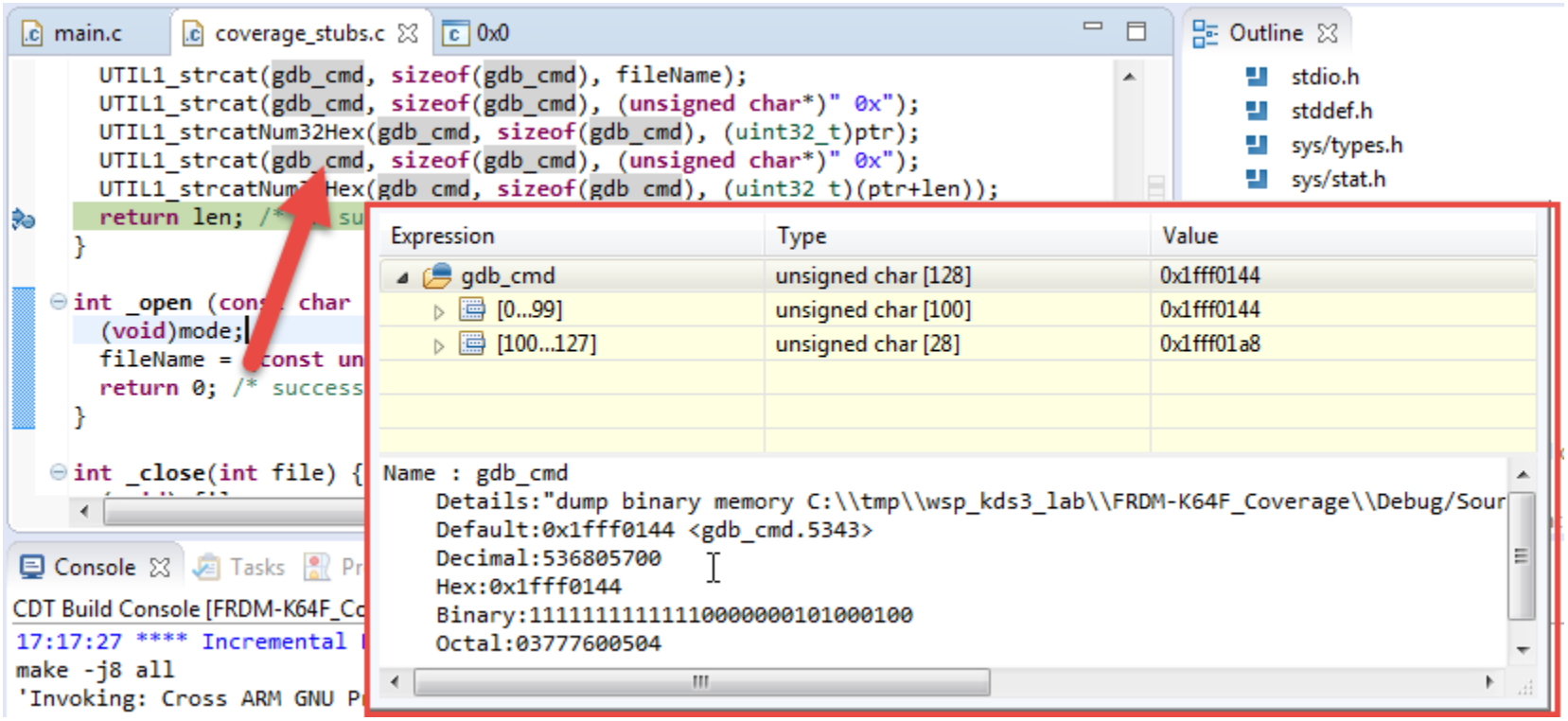
Exit Sequence: Writing Coverage Information

- Have a breakpoint set on _write() exit
- Debugger will stop when application calls _exit()



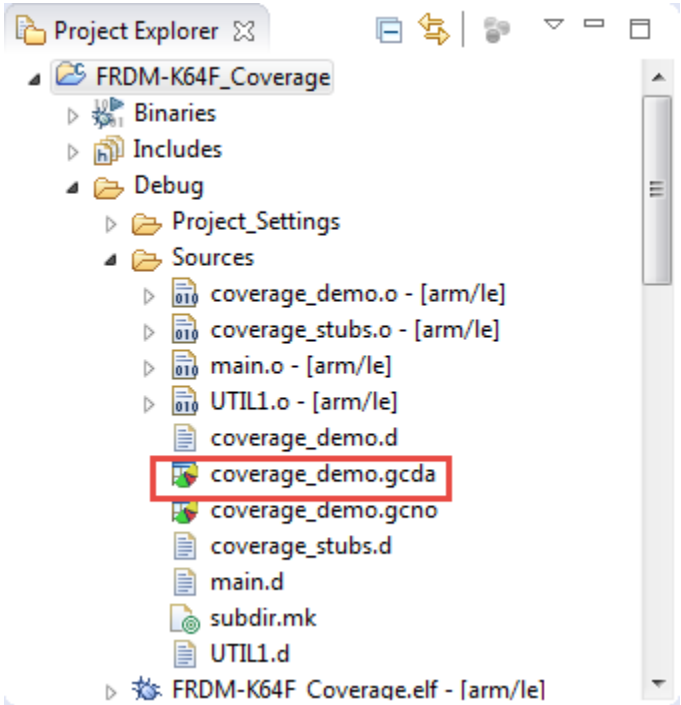
Construction of Dump Command

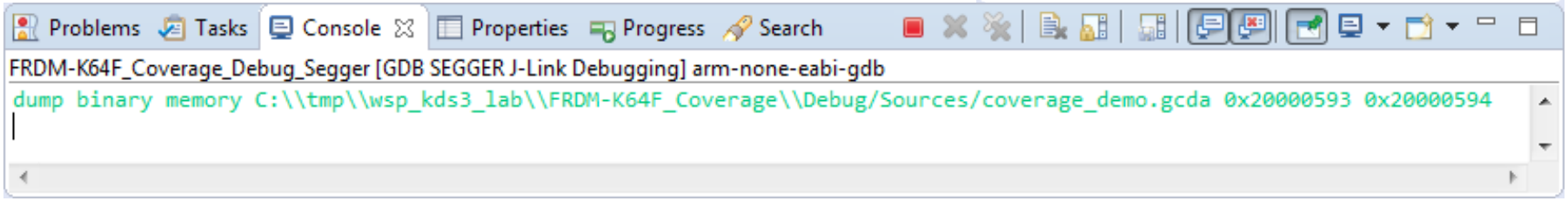
- Hover over gdb_cmd to show pop-up window to show variable
- Click into pop-up and copy command to clip board (CTRL+C)



Saving File

- Paste command (CTRL+V) to **arm-none-eabi-gdb** console
- Creates .gcda file in Debug folder
  - Refresh project (context menu on project folder)





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