

Our Cl Journey

How our Firmware Team in Siemens Mobility moved to Continuous Integration

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siemens.co.uk/traffic

On your marks, ...



Pre - Jan 2017

Took an age to

- Capture Requirements
- Make and sell the Business Case
- Evaluated QI tools, selected Lattix, Klocwork, VectorCAST

On your marks, get set, ... Code !!



Jan 2017 – first cut of code - STM32Cube

- Embedded targets generated by STM32Cube
- Fortnightly Sprints, end-of-sprint builds (2 day)
- Eclipse IDE, CVS, Keil and Klocwork Plugins
- Use of changesets, post-checkin reviews
- Push back from engineers on Quality Tools



On your marks, get set, ... Code !!



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Sep 2017 – first Build – 1 month bring up

The Problem of Technical Debt

verifa



verifa



Continuous Integration (CI) is a development practice that requires developers to integrate code into a shared repository several times a day. Each check-in is then verified by an automated build, allowing teams to detect problems early.

By integrating regularly, you can detect errors quickly, and locate them more easily.

Source: https://www.thoughtworks.com/continuous-integration

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On your marks, get set, ... have a practise



Feb 2018 – Verifa trial via Jenkins CVS plugin

- Proof of concept to show value of CI
- Attempt to automate VectorCAST testing
- Bug detection bug found on first pipeline run
- Proved need to automatically integrate and test software much more regularly

On your marks, get set, ... Continuously Integrate !!



July 2018 – we take the plunge

 Repos move to code.siemens (Github based)

Group Runners



Available group Runners : 2

🔵 63ba965a

md1z98tc

#3333

flash keil vcast_development

9f768e0b

md1yr95c

#3158

certified keil kwadmin lattix vcast windows

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Why

We received several requests by developers to support them with ready to use answers to questions form their management about why their units shall sponsor and support the use of code.siemens.com. Here are some arguments you can use:

- collaboration across Siemens
 - one platform instead of many islands
 - best practice sharing on coding and ci/cd
 - not a platform only, it's a community with > 20000 users
 - use for open, inner and closed source up to ACP 2-2-2
- security
 - pentest every year
 - protection concept
 - ACP 2-2-2 rating
- operations
 - managed by pros
 - scales up
- cost savings
 - 。 67€/user per month was the estimate for ACP3-3-3 GitLab
 - open source based, no license fees
 - typical cost structure: license fees, compute and storage, network, operations, security, monitoring, support
- one stop shop
 - more than source code repository
 - issue tracking
 - continuous integration / delivery
 - APIs to automate further
 - docker.siemens.com
 - shared build runners included
 - option to use private runners

Continuously Integrate – Verifa Consultancy, Phase 1

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July 2018 – Verifa Consultancy, Phase 1

- Repos move to code.siemens (Github based)
- Verifa consultant on-site for one week
- CI Pipeline-on-Push, build+klocwork+Doxygen
- CI Pipeline-on-Merge, build+klocwork upload

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Continuously Integrate – Verifa Consultancy, Phase 1



Author / Department

July 2018 – Verifa Consultancy, Phase 1

- Repos move to code.siemens (Github based)
- Verifa consultant on-site for one week
- CI Pipeline-on-Push, build+klocwork+Doxygen
- CI Pipeline-on-Merge, build+klocwork upload
- CI Pipeline-on-Pipeline for 23 submodules



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```
build-boot-master:
# Performs a build check on any master action, and also generates the klocwork build settings
# Variables set include:
# ADD VALID CHECKSUM: 1 - indicates that a valid checksum is to be added to the built file
 stage: build-boot
 Require runner to be Windows machine with Certified Keil Compiler
 tags:
   - windows
   - keil
   - certified
 only:
   - master
   - tags
 if the MASTER_BUILD variable is set, perform a git checkout master for each sub-module
 prior to running the script
 before script:
   - git submodule status
   - if defined MASTER BUILD ( echo Build with pipeline-support master HEAD &&
                               git submodule foreach "git checkout master && git pull origin master"
                               && git submodule status)
   - cd CPU2\CPU2 STM32F100V8\MDK-ARM\boot
   - call .\%PIPELINE PATH%\init-environment.cmd
   - .\%PIPELINE PATH%\build-uv4.cmd
   PROJECT: "%PROJECT BOOTLOADER%"
   PIPELINE PATH: "..\\..\\..\\pipeline support"
   # save built files to code.siemens.com
   # These include the klocwork settings file, which can be re-used in the subsequent klocwork-boot-master job
   # (note that both these jobs are guaranteed to run on the certified machine).
   # The Job artifacts can be downloaded from the build-boot-master Job page for formal testing
   # or when creating a release.
   when: on success
   name: "%CI JOB NAME%-%CI COMMIT SHA%"
   paths:
   - CPU2\CPU2 STM32F100V8\MDK-ARM\boot\CPU2 STM32F100V8\CPU2 STM32F100V8 boot.map
   - CPU2\CPU2 STM32F100V8\MDK-ARM\boot\CPU2 STM32F100V8\CPU2 STM32F100V8 boot.hex
   - CPU2\CPU2 STM32F100V8\MDK-ARM\boot\CPU2 STM32F100V8\CPU2 STM32F100V8 boot.axf
   - CPU2\CPU2 STM32F100V8\MDK-ARM\boot\CPU2 STM32F100V8\CPU2 STM32F100V8 boot.build log.htm
   - CPU2\CPU2 STM32F100V8\MDK-ARM\boot\kwinject build.out
   expire in: 1 week
```

Continuously Integrate – Verifa Consultancy, Phase 2



July 2018 – Verifa Consultancy, Phase 1

- Repos move to code.siemens (Github based)
- Verifa consultant on-site for one week
- CI Pipeline-on-Push, build+klocwork+Doxygen
- CI Pipeline-on-Merge, build+klocwork upload
- CI Pipeline-on-Pipeline for 23 submodules

Oct 2018 – Verifa Consultancy, Phase 2

- Improved Infrastructure pipeline machine
- CI Pipeline Architectural Analysis, Lattix
- CI Pipeline L1 Unit Test, VectorCAST
- CI Pipeline Change-based testing (git diff)
- Scheduled pipelines for Unit Test
- Push back from management on licences
- Sprint test builds on demand (4 hours)

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Unit	Subprogram	Complexity	Statements	Branches
application.c	init_system	6	27 / 31 (87%)	14 / 18 (77%)
	init_peripherals	2	9 / 9 (100%)	3 / 3 (100%)
	GSPI_generic_systemReset	2	2 / 2 (100%)	3 / 3 (100%)
	GSPI_generic_setLowPower	1	2 / 2 (100%)	1 / 1 (100%)
	GSPI_generic_getLowPower	1	1 / 1 (100%)	1 / 1 (100%)
	init_software	2	47 / 47 (100%)	3 / 3 (100%)
	init_modules	6	13 / 13 (100%)	11 / 11 (100%)
	application_main	1	1 / 1 (100%)	1 / 1 (100%)
	softwareErrorAppCallback	1	1 / 1 (100%)	1 / 1 (100%)
	productionTestControl	1	1 / 1 (100%)	1 / 1 (100%)
	getProductionTestStatus	1	1 / 1 (100%)	2 / 3 (66%)
	APPLICATION_get_address	1	1 / 1 (100%)	1 / 1 (100%)
	APPLICATION_get_wd_faults	5	8 / 8 (100%)	9 / 9 (100%)

Verifa Consultancy helped get things rolling

Allowed engineers to continue "adding value" First month - £10K

- Active projects moved from CVS to code.siemens, with use of pipelines from day 1
- Engineers now work on multiple branches
- Integration of existing tooling, e.g. Keil uv4, Klocwork, Doxygen, gave confidence
- Automated invocation of application pipeline on sub-module merge, re-use across products
 Second month - £11K
- Architectural compliance to future proof
- Automated Unit Target testing in pipeline
- Scheduled pipelines defined
- Siemens pipeline available via choco install
- Tools licensing issues caused delays



Status Report



SIEMENS

Ingenuity for life

Continuously Innovate – engineers go off-piste



Dec 2018 – Release scripting

Release script in tools submodule

Jan 2019 – Top level build in AWS Docker

- Sprint test builds on demand (3 hours)
- Definition of Unit Tests for Safety Critical code
 Feb 2019 EMC Test build
- No test failures

Tip: There are many ways to interact with the code base. Tortoise Git, Git for Windows, Eclipse EGit, all have their advocates ...



Final Comments

"I only realised I didn't have the Klocwork plugin set up on Eclipse because the pipeline failed" "Separate work on branches" "Review & resolve actions before merge" "Visibility of history is clear: branches & changes & differences" "Standard products (git & GitLab) so much help available on the internet" "Checks of pushes/merges done by pipelines" "Build artefacts available from pipelines" "Introduced quickly & easily into ongoing project" "Improved framework for managing codebase" "Eclipse seems to have poor support for git, particularly sub-modules." Recommend using command line."

SIEMENS Ingenuity for life





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