arm

Updates of TF-M build system restructure

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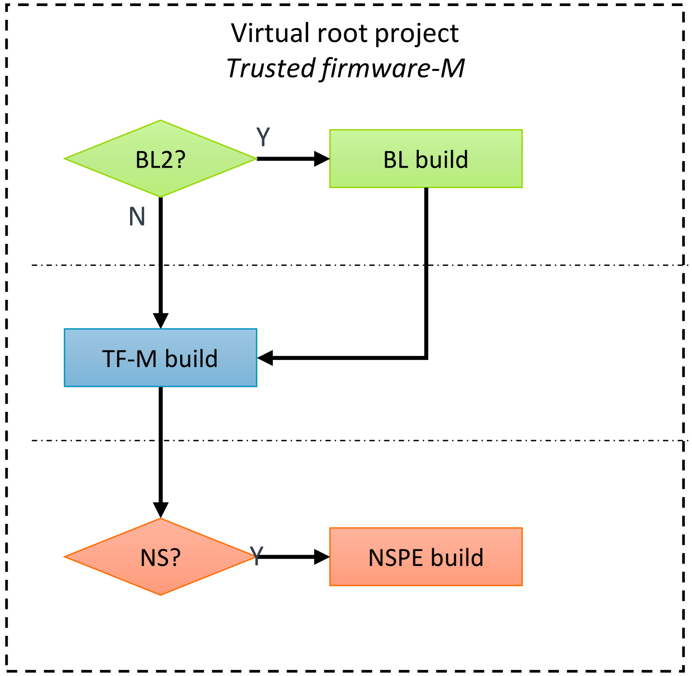
March 16, 2023

Build split

Review of proposal

- Separate builds of BL, TF-M SPE and NSPE
  - Build each module as a CMake external project under a virtual root project
  - Simulate actual NS + TF-M integration scenarios
  - Simplify build configuration, such as multi-core settings and FP compiler flags



```
if(BL2)
    ExternalProject_Add(BL2
        ......
    )
endif()
```

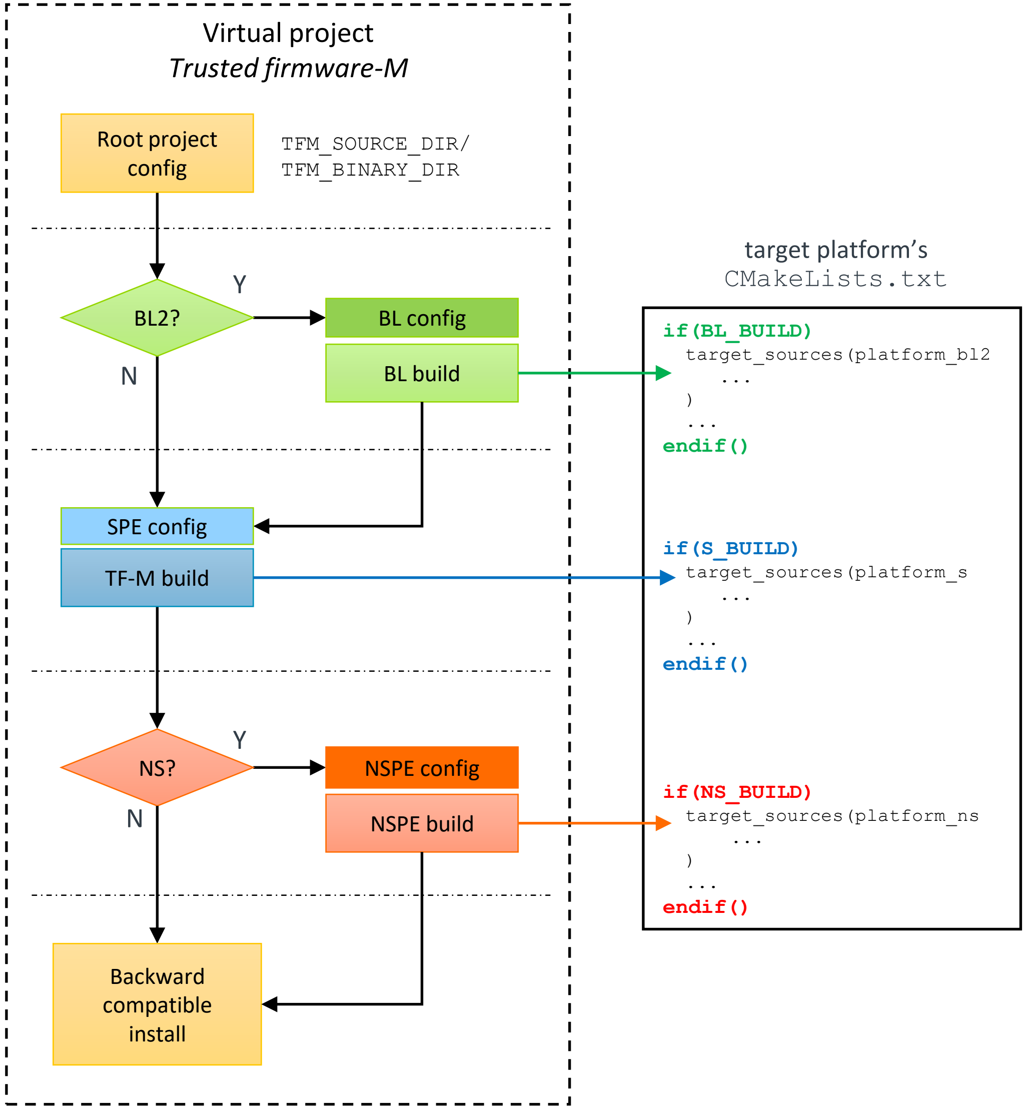
```
ExternalProject_Add(TF-M-SPE
    ......
)
```

```
if(NS)
    ExternalProject_Add(TF-M-NSPE
        ......
    )
endif()
```

Implementation

Major restructure

- Almost identical to those in proposal
  - A virtual root project + independent external projects
    - A root configuration step for fundamental configs
    - Collect command line arguments in root project and pass them to external projects
  - Secure/non-secure/bootloader specific configs
    - And share common config
  - Flags `S_BUILD/NS_BUILD/BL_BUILD` indicate current build
    - Also used to wrap platform builds
    - Alternatively separate platform `CMakeLists.txt` into `platform_s/ns/bl.cmake`
  - Define root source/build directory variables `TFM_SOURCE/BINARY_DIR`, to replace `CMAKE_SOURCE/BINARY_DIR`
    - `CMAKE_SOURCE/BINARY_DIR` vary in each external project

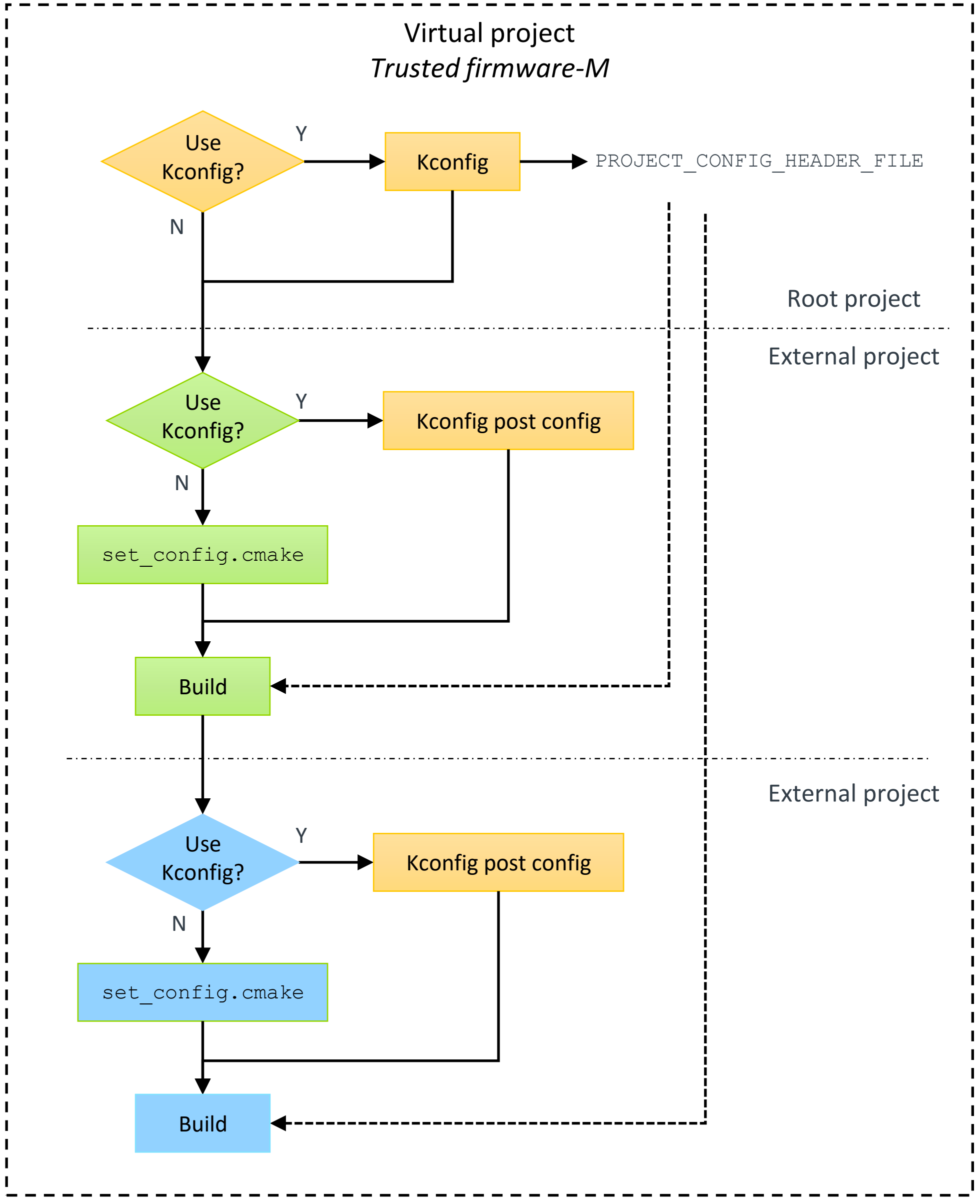


```
if(BL_BUILD)
  target_sources(platform_bl2
     ...
  )
  ...
endif()

if(S_BUILD)
  target_sources(platform_s
     ...
  )
  ...
endif()

if(NS_BUILD)
  target_sources(platform_ns
      ...
  )
  ...
endif()
```

Implementation

New features since proposal

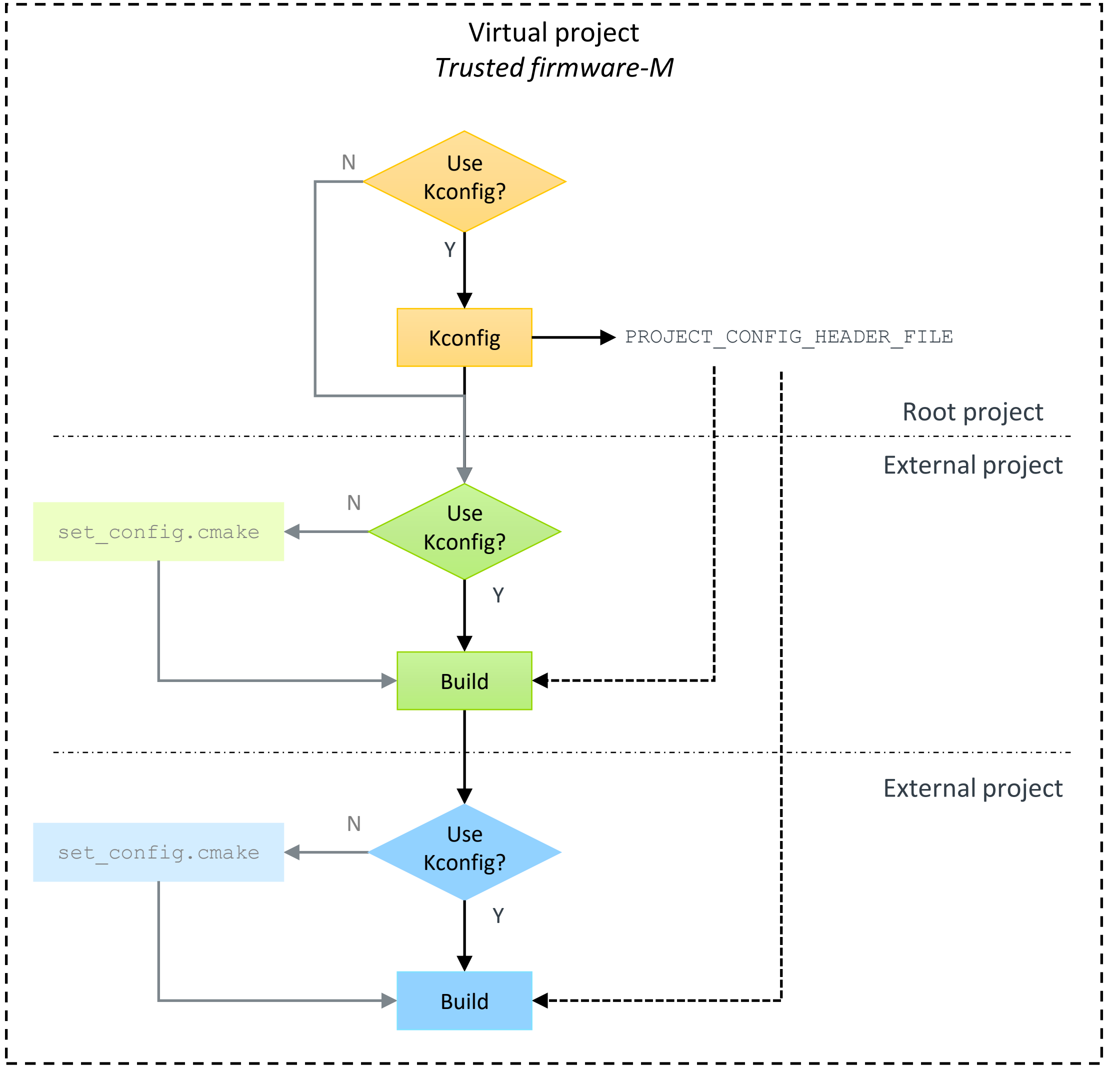
- Integrate Kconfig-based configuration
  - Kconfig generates a common project config header file which can be easily included by all external projects
  - Still require a post config step to collect configs not supported yet (by Kconfig)



Implementation

New features since proposal

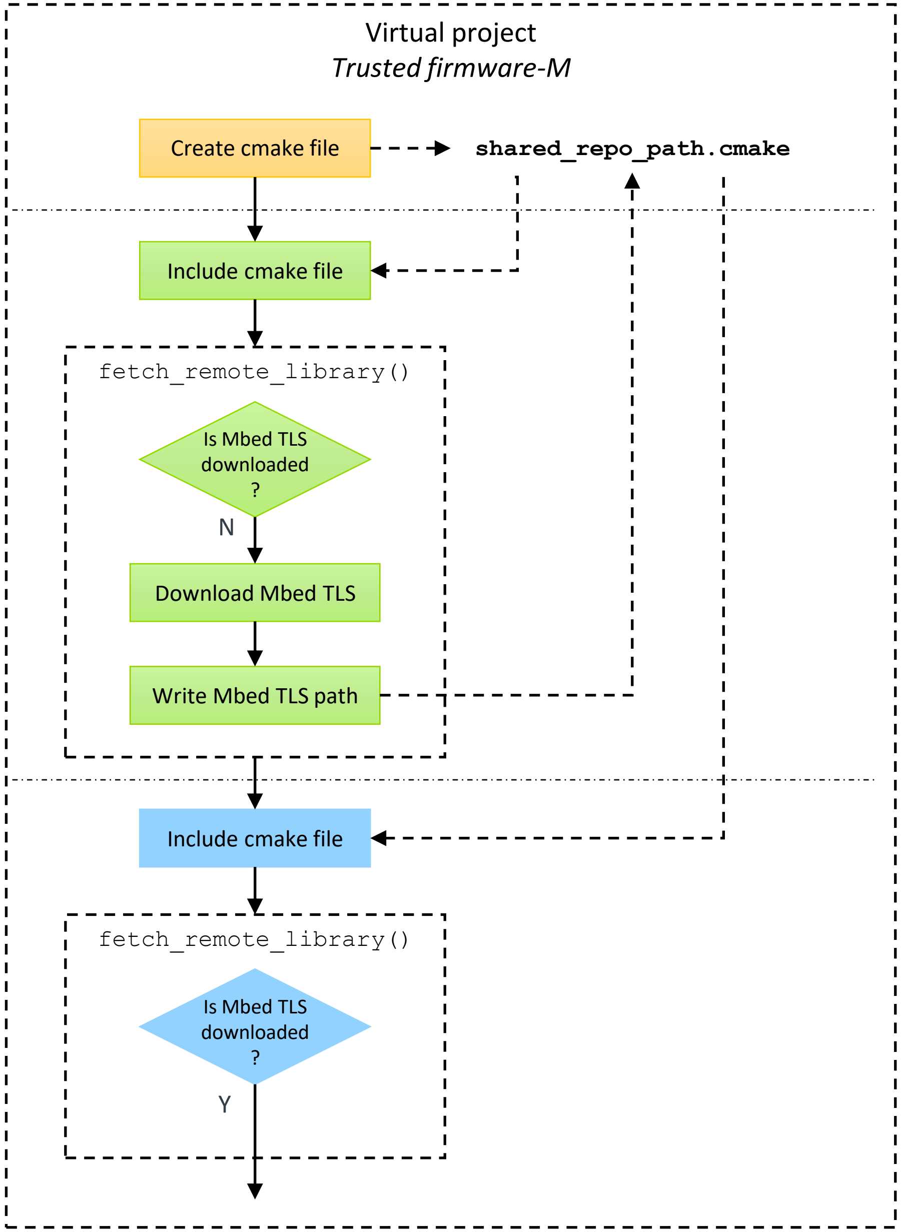
- Integrate Kconfig-based configuration
  - Simplify the overall configuration after Kconfig can support more configs
  - By skipping duplicated configuration steps in multiple external projects



Implementation

New features since proposal

- Download 3rd party libraries only once
  - Avoid duplicated downloads of shared 3rd party libraries used by multiple projects.
  - Paths of 3rd party libraries are maintained in a temporary CMake file under build folder
  - When a 3rd party library is requested for the first time, its path is written into the temporary CMake file
  - All external projects include this temporary CMake file to fetch 3rd party library which have been downloaded.
  - Implemented in `fetch_remote_library()`. Main routines are unaware of this change.



Progress and status

- Patch status
  - Patch set under review
    - TF-M changes
    - tf-m-tests changes
  - OpenCI nightly test passed
    - With some tweaks on static check
- Plan
  - Any review comment is welcome!
  - Documentation update
  - It is expected that major implementations can be merged in 2023Q2

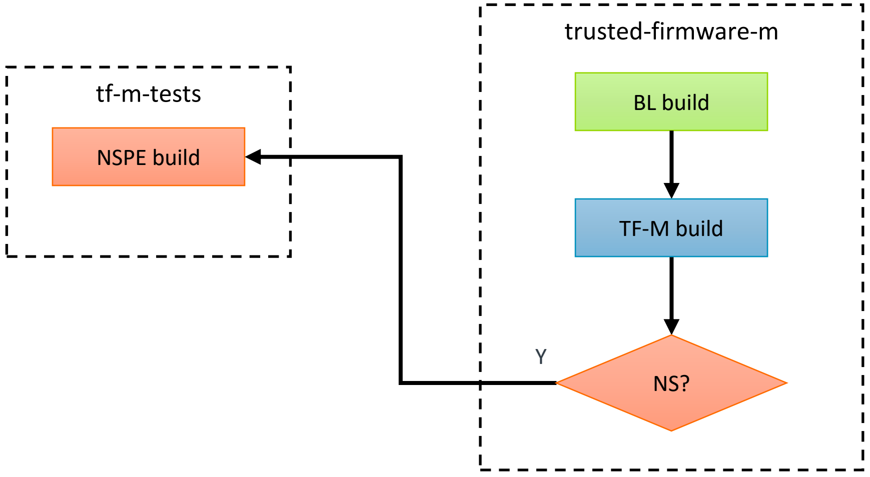
A step forward

Build NS from NS

Start NS/tests build from tf-m-tests

Current build sequence

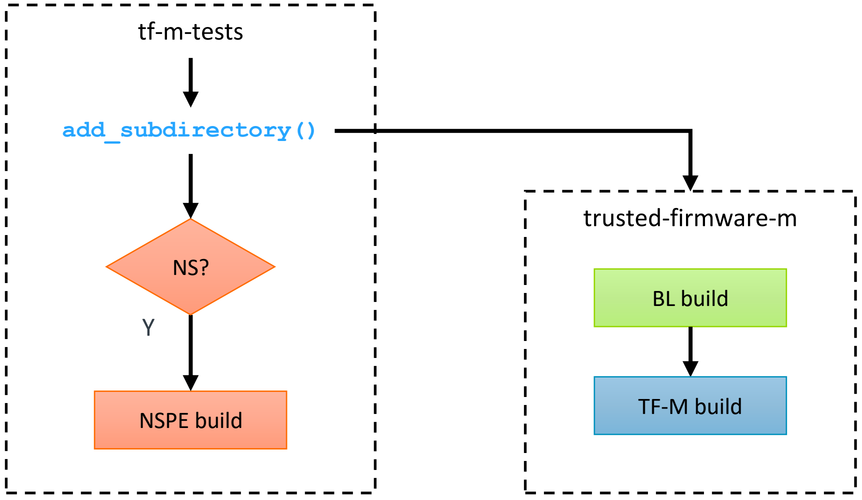
- All types of builds are triggered from TF-M
  - tf-m-tests is integrated as a component
  - TF-M and tf-m-tests are tightly coupled



Build TF-M/TF-M + NS/TF-M + Regression/TF-M + PSA Arch tests ...

Proposed build sequence

- Invert the dependency
  - TF-M alone builds secure images only
  - Build NS/Regression/PSA Arch tests from tf-m-tests

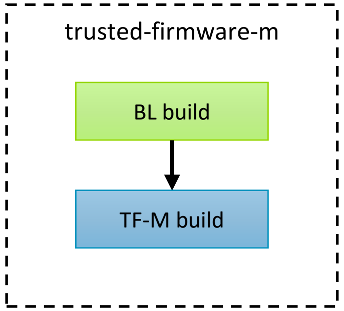


Build TF-M + NS/TF-M + Regression/TF-M + PSA Arch tests ...

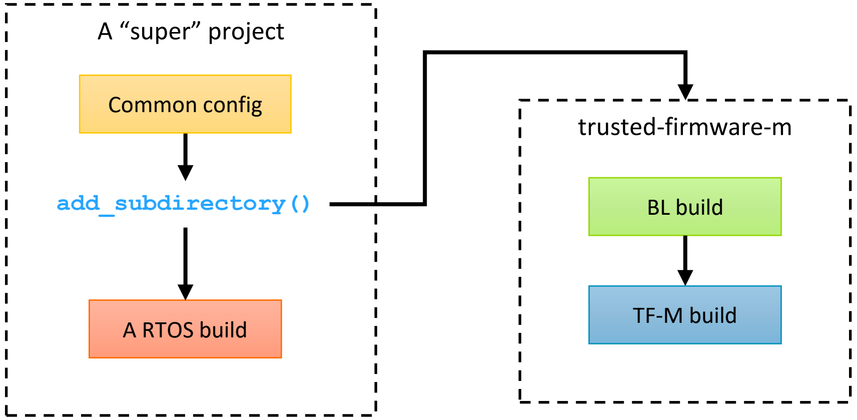
Build TF-M secure images alone

What’s the benefit?

- Simplify TF-M development and integration
  - Minimize complexities of various NS scenarios in TF-M, such as diverse NS app source directories.
  - Integrate TF-M with another NS implementation simply via `add_subdirectory()`
  - TF-M only focus on its own 3rd party dependencies. Tf-m-tests takes over the management of regression tests and PSA Arch tests.



Build TF-M secure images alone.
Secure binaries are released for
downstreaming integration

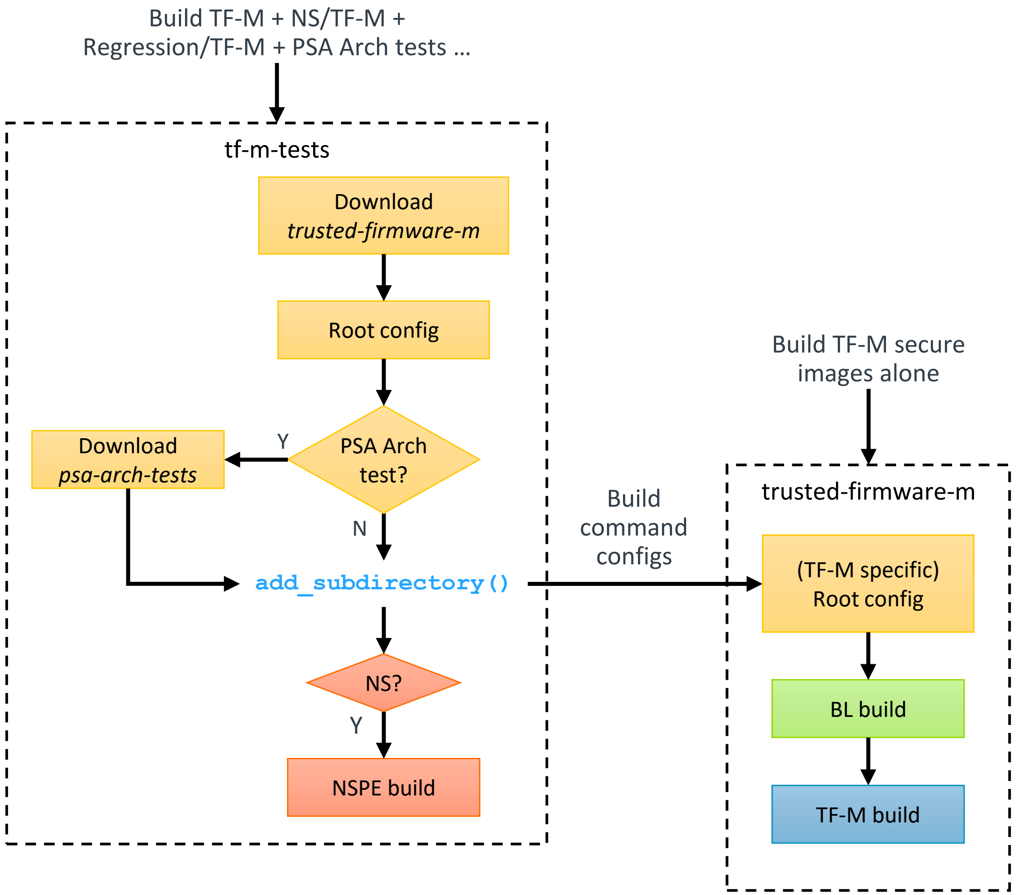


Build TF-M together with NS RTOS.
Minimize the effort to configure TF-M to fit NS specific
implementation, for example `NS_EVALUATION_APP_PATH` is
unnecessary any more

Implementation

Straightforward based on build split

- Tf-m-tests
  - Download *latest* trusted-firmware-m
    - Still rely on trusted-firmware-m cmake utils and common config
  - Build S via `add_subdirectory()`
  - Build NS as an external project
- Trusted-firmware-m
  - Remove NS build
  - Support to accept parent scope configuration
    - Build command configs
- OpenCI
  - Trigger regression tests from tf-m-tests
  - tf-m-tests patches can be verified via openCI



Build TF-M + NS/TF-M + Regression/TF-M + PSA Arch tests ...
tf-m-tests
Download *trusted-firmware-m*
Root config
PSA Arch test?
Y
Download *psa-arch-tests*
N
add_subdirectory()
NS?
Y
NSPE build
Build command configs
Build TF-M secure images alone
trusted-firmware-m
(TF-M specific) Root config
BL build
TF-M build

Side effects

- Tweak the build scripts
  - Build regression tests/PSA Arch tests from tf-m-tests folder
  - Otherwise, TF-M build fails with test flags set

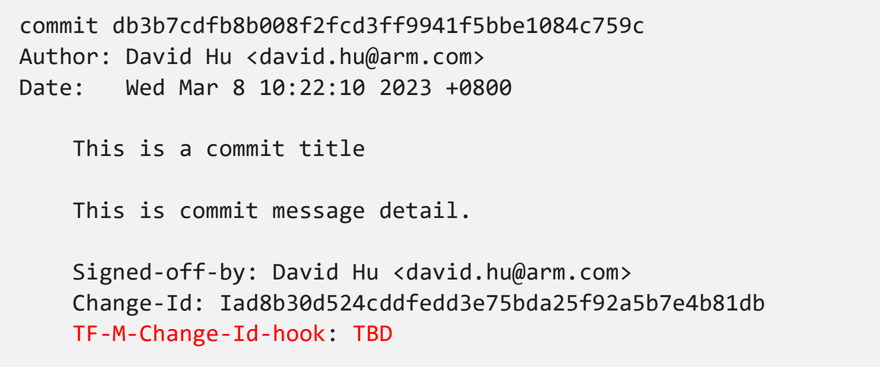
Side effects

- TF-M and tf-m-tests commit synchronization
  - tf-m-tests always downloads *latest* TF-M code base in this proposal
    - It is the responsibility of tf-m-tests to track and verify TF-M latest master branch
    - TF-M is updated frequently. Extremely inconvenient to track and update TF-M commit ID in tf-m-tests.
    - It enables tf-m-tests patches to be verified by per-patch CI
      - If those patches only affect tf-m-tests

  - However
    - If users work on a specific TF-M/tf-m-tests commit, it becomes difficult to figure out the corresponding peer commit.

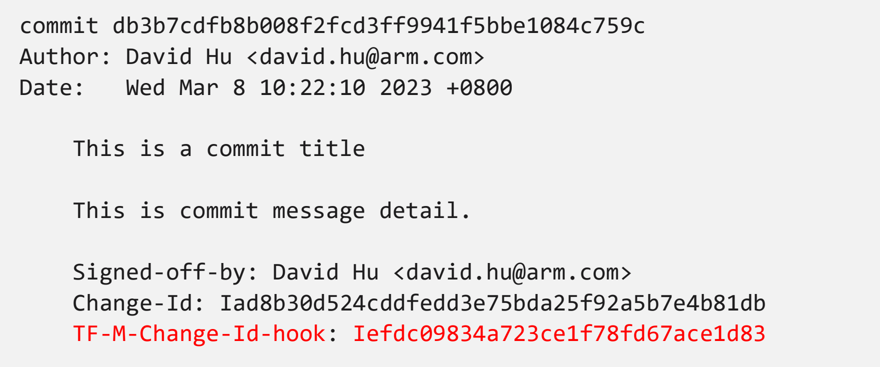
Side effects

- TF-M and tf-m-tests commit synchronization
  - Insert a trailer in *tf-m-tests* commit message to “hook” a TF-M *change ID*
    - Tf-m-tests git commit-msg automatically inserts a `TF-M-Change-Id-hook` trailer when committing
    - The trailer value is set to `TBD` as a dummy one by default
    - Developers shall manually fill in the corresponding TF-M Change ID
    - The Change ID keeps the same while the commit ID varies during development of a patch



```
commit db3b7cdfb8b008f2fcd3ff9941f5bbe1084c759c
Author: David Hu <david.hu@arm.com>
Date:   Wed Mar 8 10:22:10 2023 +0800

    This is a commit title

    This is commit message detail.

    Signed-off-by: David Hu <david.hu@arm.com>
    Change-Id: Iad8b30d524cddfedd3e75bda25f92a5b7e4b81db
    TF-M-Change-Id-hook: TBD
```

`git commit -s …`



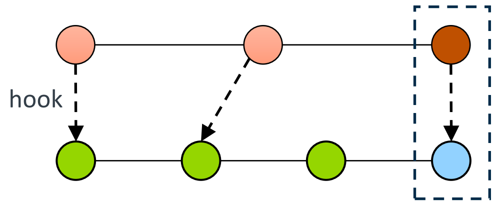
```
commit db3b7cdfb8b008f2fcd3ff9941f5bbe1084c759c
Author: David Hu <david.hu@arm.com>
Date:   Wed Mar 8 10:22:10 2023 +0800

    This is a commit title

    This is commit message detail.

    Signed-off-by: David Hu <david.hu@arm.com>
    Change-Id: Iad8b30d524cddfedd3e75bda25f92a5b7e4b81db
    TF-M-Change-Id-hook: Iefdc09834a723ce1f78fd67ace1d83
```

`git commit --amend`

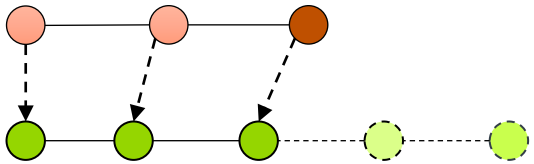
Side effects

TF-M and tf-m-tests commit synchronization

- Insert a trailer in *tf-m-tests* commit message to “hook” a TF-M *change ID*



Hook tf-m-tests change to the
coupled TF-M commit



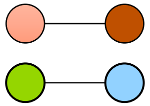
Hook tf-m-tests change to the “current” latest TF-M commit.

If other commits are merged in TF-M during development,
unnecessary to update the hook.

But eventually CI tests with the latest TF-M shall be passed.

tf-m-tests commits

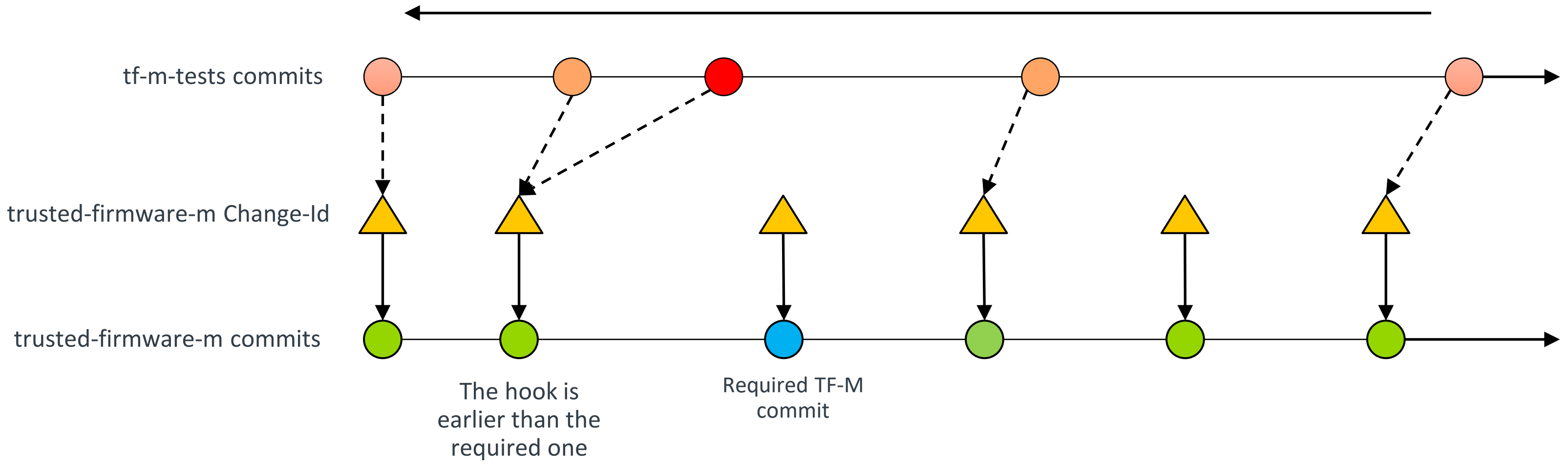
trusted-firmware-m commits



Side effects

- TF-M and tf-m-tests commit synchronization
  - Users work on a specific *tf-m-tests* commit
    - Locate the corresponding TF-M commit according to the `TF-M-Change-Id-hook`
    - Use a local copy of TF-M repo with the corresponding commit ID
  - Users work on a specific *TF-M* commit
    - TF-M provides a tool to locate the corresponding tf-m-tests commit
    - Use a local copy of tf-m-tests repo with the commit ID found out by the tool

Search in tf-m-tests git log in reverse order .
Look for the first tf-m-tests commit whose TF-M hook is earlier than the required one.


tf-m-tests commits
trusted-firmware-m Change-Id
trusted-firmware-m commits
The hook is earlier than the required one
Required TF-M commit

Status

- A PoC for preview
  - TF-M patch
  - Tf-m-tests patch

- Ongoing tasks
  - OpenCI
    - Tweak tests build
    - Enable per-patch CI check against tf-m-tests trailer
  - tf-m-tests
    - Enable the trailer in commit-msg hook
  - TF-M
    - Implement the tool for locating tf-m-tests commit

Thank You

Danke

Gracias

Grazie

谢谢

ありがとう

Asante

Merci

감사합니다

धन्यवाद

Kiitos

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