

Cross Platform Development for Raspberry

Cross-development means developing and compiling programs on another platform then it intended to run upon. It is a common approach for Pi, since it's also how Raspian is built. For quite some time I did compile Pi applications on the Pi itself. Which works quite well, but has one large drawback: performance. Being able to compile these programs on my 8 core 16GB desktop, improved compilation time enorm. And it is quite simple.

There are multiple approaches to setup a cross-compile environment. The most essential aspect is the following:

1. Exact **identical Linux/Debian versions** on X86 build host and Raspberry runtime target
 2. **Different Linux/Debian versions** on X86 build host and Raspberry runtime target
1. [Setup for Identical Debian versions](#)
 2. [Setup for Different Debian versions](#)

[crossbuild-essential-armhf](#)

Compatibility rule

Build against the oldest operating-system release and CPU that the resulting binary must support.

Do not link a Bookworm target against Trixie ARM libraries. Doing so can create dependencies on newer glibc or library symbols that are unavailable on the Bookworm target.

For example:

Incorrect:

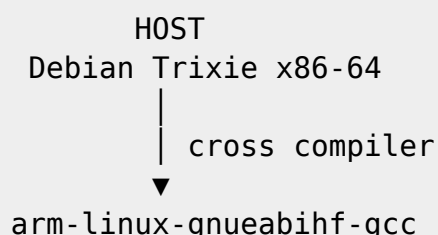
Trixie compiler + Trixie armhf libraries -> Bookworm target

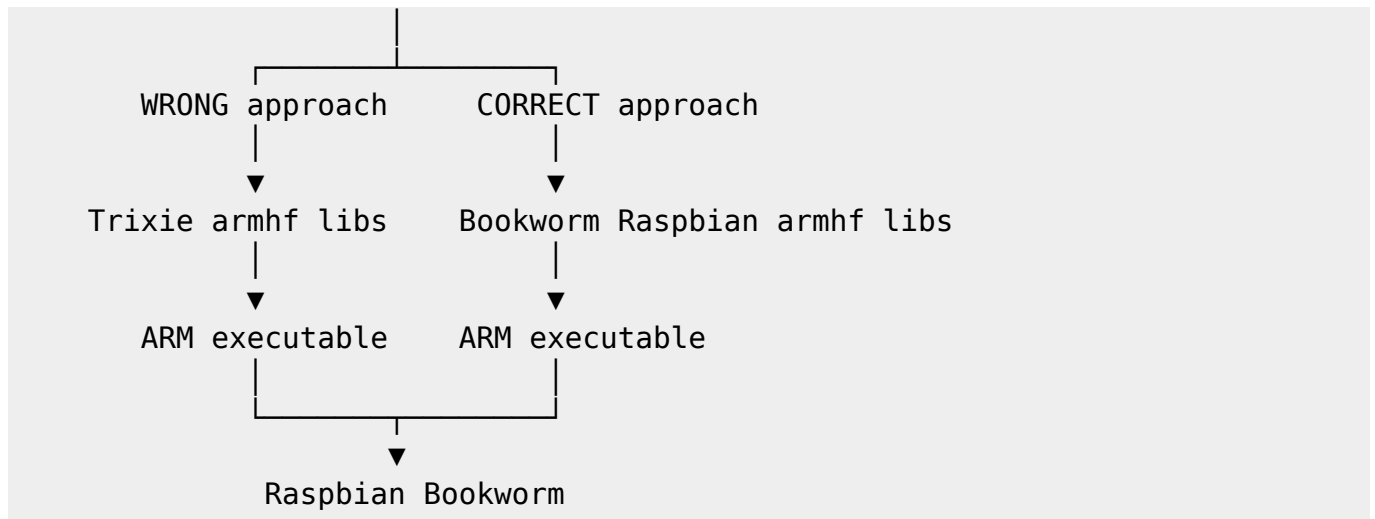
Correct:

Trixie compiler + Bookworm armhf sysroot -> Bookworm target

The problem with different host and target ARM libraries

The important guideline is that **the target system's ABI, headers, libraries and library versions vs. what you build against**. For example:





Suppose your **x86 host is Debian Trixie**, and you install **libc6:armhf** from Trixie. Your compiler might then build against something like **glibc 2.41** while your Raspberry Pi's Raspbian Bookworm has **glibc 2.36**. Your executable may therefore acquire a dependency on a newer GLIBC symbol. For example, conceptually:

```
program
├─ was linked against and requires GLIBC_2.41
│
├─
│   └─ Raspbian Bookworm only has GLIBC_2.36
│       └─ x
│           └─ program won't run, with errors like:
│               ".../lib/arm-linux-gnueabi/libc.so.6: version `GLIBC_2.41' not
│               found..."
```

This is one of the most common reasons why **building on a newer distribution for an older target** causes trouble. It isn't only the **libraries** that matter. The headers matter too. Suppose you compile against Trixie's headers (*/usr/include*), but run on Bookworm. You can potentially get differences in:

- API definitions
- feature macros
- structure definitions
- constants
- kernel interfaces
- glibc interfaces
- library-specific APIs

So the ideal relationship is:

That's why a **target-specific sysroot** is the clean solution.

But the reverse is usually fine

If you deliberately want to require a newer target system, that's perfectly legitimate. For example:

```
Build against Trixie armhf
      ↓
Deploy only to Trixie armhf
      ↓
    No problem.
```

The rule is simple: **Don't build against a newer userspace than the oldest target you intend to support.** This is particularly important for glibc.

Raspberry Pi OS vs Debian armhf

One important distinction: Raspberry Pi OS vs Debian armhf. Raspberry Pi OS is Debian-derived, but its 32-bit repository contains packages built for Raspberry Pi hardware and may contain versions or patches marked with +rpt. Use the Raspberry Pi OS repositories when Raspberry Pi OS is the target. Use Debian repositories only when the target is Debian armhf.

If your target is **Raspberry Pi OS 32-bit**, don't blindly assume that Debian Bookworm's armhf libraries are an exact match. Debian itself points this out:

Raspberry Pi OS armhf can be subtly incompatible with Debian armhf.

In particular, Raspberry Pi OS/Raspbian has historically had differences in its ARM ABI/build configuration. Debian recommends using a target-specific chroot when cross-compiling packages for Raspberry Pi OS armhf. ([Debian Wiki][2])

Links

- <https://developer.arm.com/downloads/-/arm-gnu-toolchain-downloads>
- https://www.acmesystems.it/arm9_toolchain
- <https://jensd.be/1126/linux/cross-compiling-for-arm-or-aarch64-on-debian-or-ubuntu>
- <https://learn.arm.com/install-guides/gcc/cross/>
- <https://packages.debian.org/search?keywords=crossbuild-essential>
- <https://www.get-edi.io/assets/pdfs/DebianCross.pdf>
- <https://prashanth.entertolearn.in/debian-arm-architecture-and-emulation/using-debian-arm-cross-compiler-for-bare-metal-programming>

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