

## eBPF sample programs

This directory contains a test stubs, verifier test-suite and examples for using eBPF. The examples use libbpf from tools/lib/bpf.

## Build dependencies

Compiling requires having installed:

- clang >= version 3.4.0
- llvm >= version 3.7.1

Note that LLVM's tool 'llc' must support target 'bpf', list version and supported targets with command: `llc --version`

## Clean and configuration

It can be needed to clean tools, samples or kernel before trying new arch or after some changes (on demand):

```
make -C tools clean
make -C samples/bpf clean
make clean
```

Configure kernel, defconfig for instance:

```
make defconfig
```

## Kernel headers

There are usually dependencies to header files of the current kernel. To avoid installing devel kernel headers system wide, as a normal user, simply call:

```
make headers_install
```

This will create a local "usr/include" directory in the git/build top level directory, that the make system automatically picks up first.

## Compiling

For building the BPF samples, issue the below command from the kernel top level directory:

```
make M=samples/bpf
```

It is also possible to call `make` from this directory. This will just hide the invocation of `make` as above.

## Manually compiling LLVM with 'bpf' support

Since version 3.7.0, LLVM adds a proper LLVM backend target for the BPF bytecode architecture.

By default `llvm` will build all non-experimental backends including `bpf`. To generate a smaller `llc` binary one can use:

```
-DLLVM_TARGETS_TO_BUILD="BPF"
```

We recommend that developers who want the fastest incremental builds use the Ninja build system, you can find it in your system's package manager, usually the package is `ninja` or `ninja-build`.

Quick snippet for manually compiling LLVM and clang (build dependencies are `ninja`, `cmake` and `gcc-c++`):

```
$ git clone https://github.com/llvm/llvm-project.git
$ mkdir -p llvm-project/llvm/build
$ cd llvm-project/llvm/build
$ cmake .. -G "Ninja" -DLLVM_TARGETS_TO_BUILD="BPF;X86" \
  -DLLVM_ENABLE_PROJECTS="clang" \
  -DCMAKE_BUILD_TYPE=Release \
  -DLLVM_BUILD_RUNTIME=OFF
$ ninja
```

It is also possible to point `make` to the newly compiled 'llc' or 'clang' command via redefining `LLC` or `CLANG` on the `make` command line:

```
make M=samples/bpf LLC=~/.git/llvm-project/llvm/build/bin/llc CLANG=~/.git/llvm-project/llvm/build/bin/clang
```

## Cross compiling samples

In order to cross-compile, say for `arm64` targets, export `CROSS_COMPILE` and `ARCH` environment variables before calling `make`. But do this before `clean`, `configuration` and `header install` steps described above. This will direct `make` to build samples for the cross target:

```
export ARCH=arm64
export CROSS_COMPILE="aarch64-linux-gnu-"
```

Headers can be also installed on RFS of target board if need to keep them in sync (not necessarily and it creates a local "usr/include")

directory also):

```
make INSTALL_HDR_PATH=~/.some_sysroot/usr headers_install
```

Pointing LLVM and CLANG is not necessarily if it's installed on HOST and have in its targets appropriate arm64 arch (usually it has several arches). Build samples:

```
make M=samples/bpf
```

Or build samples with SYSROOT if some header or library is absent in toolchain, say libelf, providing address to file system containing headers and libs, can be RFS of target board:

```
make M=samples/bpf SYSROOT=~/.some_sysroot
```