

# binutils support for Xtensa

- git tree: <https://github.com/jcmvbkbc/binutils-gdb-xtensa>

## FDPIC support

- [+] static linking
- [+] PDE
- [+] PIE
- [-] PLT and lazy binding
- [-] TLS

## FDPIC instruction sequences

### Local call

Default local call

```
+0:    movi    tmp, target@GOT
+3:    add     tmp, tmp, localGOTptr
+5:    l32i   tmp, tmp, 0
+7:    mov     GOTptr, localGOTptr
+9:    callx0 tmp
```

No-GOT local call

```
+0:    movi    tmp1, target
+3:    l32i   tmp2, localGOTptr, TEXT_SEGMENT_OFFSET
+5:    add     tmp1, tmp1, tmp2
+7:    mov     GOTptr, localGOTptr
+9:    callx0 tmp1
```

When call0 reaches the target it can be transformed to

```
+0:    mov     GOTptr, localGOTptr
+2:    call0   target
```

In the j.l style it could probably be done like

```
call0.l target, tmp1, tmp2, localGOTptr
```

### PLT call

Obvious version:

```
+0:    movi    tmp, target@PLTGOT
+3:    add     tmp, tmp, localGOTptr
+5:    l32i    tmp, tmp, 0
+7:    l32i    GOTptr, tmp, 4
+9:    l32i    tmp, tmp, 0
+11:   callx0  tmp
```

```
target@PLT:
+0:    movi    a8, target@PLTGOT
+3:    add     a8, a8, GOTptr
+5:    movi    a9, target-symbol
+8:    l32i    a10, GOTptr, RESOLVER_FN
+10:   l32i    GOTptr, GOTptr, RESOLVER_GOT
+12:   jx0     a10
```

The inline part calls the PLT part only once, after resolution the inline part calls the target directly. The adjustment is done to a single GOT entry, so it's atomic. The inline part can be reduced to a fixed direct call to the PLT:

```
+0:    mov     GOTptr, localGOTptr
+2:    call0   target@PLT
```

that reduces the inline part from 14 to 5 bytes, but adds two jumps to each call and some special logic to the resolver to avoid name resolution on each call.

## Manual toolchain building script

```
#!/bin/bash -ex

target=${TARGET:-xtensa-linux-uclibcfdpic}
build_base=`pwd`/build
src_base=$(dirname $(readlink -f "$0"))
binutils_src=$HOME/ws/tensilica/binutils-gdb/binutils-gdb
gcc_src=$HOME/ws/tensilica/gcc/gcc
linux_src="$src_base/linux"
uclibc_src="$src_base/uclibc-ng"
uclibc_config_src="$src_base/uclibc-ng-config"

prefix=`pwd`
sysroot="$prefix/$target/sysroot"
linux_headers="$sysroot/usr"

_FLAGS_FOR_HOST=${FLAGS_FOR_HOST:--0g -g}
_FLAGS_FOR_TARGET=${FLAGS_FOR_TARGET:--mauto-litpools -mfdpic -0z -g}
CROSS_COMPILE=${CROSS_COMPILE:-$prefix/bin/$target-}
TARGET_CFLAGS="$_FLAGS_FOR_TARGET -D_LARGEFILE64_SOURCE -
D_FILE_OFFSET_BITS=64"

if [ "$1" = "-r" ]; then
```

```
        reconfigure=1
fi

mkdir -p .build

mkdir .build/binutils && (
    cd .build/binutils
    "$binutils_src/configure" --prefix="$prefix" \
        --target=$target \
        --with-sysroot="$sysroot" \
        --disable-shared --disable-werror --disable-gdb --disable-
gdbstub \
        CFLAGS="$_FLAGS_FOR_HOST"

    make -j8
    make -j8 install
)

mkdir .build/gcc-initial && (
    cd .build/gcc-initial
    "$gcc_src/configure" --prefix="$prefix" \
        --target=$target \
        --with-sysroot="$sysroot" \
        --enable-languages=c \
        --disable-shared \
        --enable-__cxa_atexit \
        --disable-tls --disable-threads \
        --without-headers --with-newlib \
        CFLAGS_FOR_TARGET="$_FLAGS_FOR_TARGET" \
        CXXFLAGS_FOR_TARGET="$_FLAGS_FOR_TARGET" \
        CFLAGS="$_FLAGS_FOR_HOST" \
        CXXFLAGS="$_FLAGS_FOR_HOST"

    make -j8 all-gcc
    make -j8 all-target-libgcc
    make -j8 install-gcc
    make -j8 install-target-libgcc
)

mkdir .build/linux && (
    cd .build/linux
    make -C "$linux_src" ARCH=xtensa \
        CROSS_COMPILE="$CROSS_COMPILE" O=`pwd` \
        defconfig
    make -C "$linux_src" ARCH=xtensa \
        CROSS_COMPILE="$CROSS_COMPILE" O=`pwd` \
        INSTALL_HDR_PATH="$linux_headers" \
        -j8 headers_install
)

mkdir .build/uclibc && (
```

```
cd .build/uclibc
cp "$uclibc_config_src/.config" .
if [ -n "$reconfigure" ]; then
    make -C "$uclibc_src" ARCH=xtensa \
        CROSS_COMPILE="$CROSS_COMPILE" \
        O=`pwd` KERNEL_HEADERS="$linux_headers/include" \
        UCLIBC_EXTRA_CFLAGS="$TARGET_CFLAGS" \
        menuconfig
    cp .config "$uclibc_config_src"
fi

make -C "$uclibc_src" ARCH=xtensa \
    CROSS_COMPILE="$CROSS_COMPILE" \
    O=`pwd` KERNEL_HEADERS="$linux_headers/include" \
    UCLIBC_EXTRA_CFLAGS="$TARGET_CFLAGS" \
    -j8 "$@"

make -C "$uclibc_src" ARCH=xtensa \
    CROSS_COMPILE="$CROSS_COMPILE" \
    O=`pwd` KERNEL_HEADERS="$linux_headers/include" \
    UCLIBC_EXTRA_CFLAGS="$TARGET_CFLAGS" \
    DESTDIR="$sysroot" \
    install
)

mkdir .build/gcc-final && (
    cd .build/gcc-final
    "$gcc_src/configure" --prefix="$prefix" \
        --target=$target \
        --with-sysroot="$sysroot" \
        --enable-languages=c,c++ \
        --disable-shared \
        --enable-__cxa_atexit \
        --disable-tls --disable-threads \
        --with-uclibc \
        CFLAGS_FOR_TARGET="$_FLAGS_FOR_TARGET" \
        CXXFLAGS_FOR_TARGET="$_FLAGS_FOR_TARGET" \
        CFLAGS="$_FLAGS_FOR_HOST" \
        CXXFLAGS="$_FLAGS_FOR_HOST"

    make -j8 all
    make -j8 install
)
```

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