

binutils support for Xtensa

- git tree: <https://github.com/jcmvbkb/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.

TLS General Dynamic

```
+0:    movi    a2, x@GOTTLSDESC
+3:    add     a2, a2, localGOTptr
+5:    l32i   tmp, a2, 0
+7:    l32i   GOTptr, tmp, 4
+9:    l32i   tmp, tmp, 0
+11:   callx0 tmp
```

This TLSDESC is not the same as the descriptor of the default xtensa toolchain. It contains two pointers, one to the resolver function, the other to that other descriptor containing DTPOFF and module index in the dtv.

Manual toolchain building script

```
#!/bin/bash -ex

target=${TARGET:-xtensa-linux-uclibcfpic}
build_base=`pwd`/build
src_base=$(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=${FLAGS_FOR_HOST:--Og -g}
_FLAGS_FOR_TARGET=${FLAGS_FOR_TARGET:--mauto-litpools -mfdpic -Oz -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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