This document describes the MutekH build system.

Overview of the build process

The build system take a configuration file, processes the dependancies, and compiles the desired kernel.

Depending on the targeted architecture, the output file may be an ELF (.out), a plain binary file (.bin), an intel-hex file (.hex) or an object file (.o).

The build system takes care of dependancies, file modifications, ...

User point of view

Makefile options (command line)

When building with MutekH, several options may be used to change the behavior of the build system. These options are given through variables when calling `make`, in the form:

```
$ make VAR1=value1 VAR2=value2
```

The following options are mandatory:

`CONF=`
: An absolute path to the root configuration file for the desired kernel instance.

The following options may be useful:

`VERBOSE=1`
: Prints all the commands executed

The following options are useful when building out of the source tree:

`MUTEK_SRC_DIR`
: An absolute path to the MutekH source tree. This defaults to `.`

`BUILD_DIR`
: An absolute path to the directory containing the objects and results, this defaults to `.`

`CONF_DIR`
: An absolute path to the directory containing the `.config.*` files, this defaults to `$(BUILD_DIR)`

Make targets

The following targets are available

`kernel`
: This is the default target. It builds the kernel for the specified configuration file.

`clean`
: This cleans all the compilation results

The following targets are for informational purposes

`showpaths`

This prints the modules that will be built, their paths, ?

`cflags`
: This prints the flags used for compilation

The following targets are available to get help about configuration

`listconfig`
: Prints the current configuration as expanded by MutekH build system. It also prints available --- but currently undefined --- configuration tokens.

`listallconfig`
: Prints all the configuration tokens, even the ones incompatible with the current configuration.

`showconfig`
: This prints detailed information about a given configuration token. Token must be specified with `TOKEN=` variable argument.

```
$ make showconfig TOKEN=CONFIG_PTHREAD
```

MutekH configuration files

MutekH configuration files contain tokens defining the kernel we are currently building. They must contain:

- the license for the application, enforcing license compatibility between some kernel parts and your code,
- the target architecture
- the libraries used, and their configurations
- the used drivers
- some global compilation switches (optimization, debugging, ?)

Syntax is `token` **space** `value`. Tokens begin with `CONFIG_`, `value` may be unspecified thus defaults to `defined`. e.g.

```
CONFIG_LICENSE_APP_LGPL

# Platform type
CONFIG_ARCH_EMU

# Processor type
CONFIG_CPU_X86_EMU

# Mutek features
CONFIG_PTHREAD

CONFIG_MUTEK_CONSOLE

# Device drivers
CONFIG_DRIVER_CHAR_EMUTTY

# Code compilation options
CONFIG_COMPILE_DEBUG
```

A configuration file may declare a new module, telling the build system the directory where the configuration lies has a local Makefile and some more objects to build.

```
# New source code module to be compiled
CONFIG_MODULES hello:%CONFIGPATH
```

For the list of all available tokens, do

```
$ make listallconfig
```

For a list of current available tokens depending on your configuration file, do

```
$ make CONF=path/to/config_file listconfig
```

Developer point of view

MutekH has a component-based architecture where each module declares its configuration tokens.

The xxx.config files

For each configuration token, one may use the following tags:

`desc Description string without quotes`
: Short description about the token

`parent TOKEN`
: Parent token is help screen. This is only for pretty-printing.

`require TOKEN [?]`
: Mandatory requirements, having at least one of the tokens on the line is mandatory, conflict yields error

`depend TOKEN [?]`
: Dependencies, having at least one of the tokens on the line is mandatory, conflict implicitly undefines the current token

`provide TOKEN [?]`
: Mandatory forced requirements, given tokens are defined, conflict yields an error

`provide TOKEN=value`
: Mandatory forced requirements variant, sets a configuration token to a given value; value must not be `undefined`

`provide TOKEN=+value`
: Mandatory forced requirements variant, adds a value to a configuration token

`exclude TOKEN`
: Mandatory unrequirements, the specified token must not be defined

`suggest TOKEN [?]`
: Makes a token suggest other tokens when it is used. This is for help listing.

`single TOKEN [?]`
: Require a single one of the following tokens

Example:

```
%config CONFIG_SRL
desc MutekS API
provide CONFIG_MODULES=+libsrl:%CONFIGPATH
depend CONFIG_MUTEK_SCHEDULER
depend CONFIG_MWMR
require CONFIG_SRL_SOCLIB CONFIG_SRL_STD
single CONFIG_SRL_SOCLIB CONFIG_SRL_STD
%config end
```

Here we declare a `CONFIG_SRL` token

- needing CONFIG_MUTEK_SCHEDULER and CONFIG_MWMR,
- needing one of `CONFIG_SRL_SOCLIB` or `CONFIG_SRL_STD`,
- adding the directory containing the .conf as the "libsrl" module

The directories Makefile syntax & rules

Makefiles in directories may use the following variables:

`objs`
: A list of .o files compiled from `.c`, `.s` or `.S` files

`meta`
: A list of files that may be translated from `.m4`, `.cpp` or `.def` files

`copy`
: A list of files that must be copied verbatim from source directory to object directory

`subdirs`
: A list of subdirectories where more files are to be processed. These directories must exist and contain a `Makefile`.

Makefiles may contain optional flags that may be used for compilation:

`file.o_CFLAGS=?`
: CFLAGS to use for a given object

`DIR_CFLAGS=?`
: CFLAGS to use for all the objects compiled by the current Makefile. Flags added by this setting add-up with the object-specific ones above.

Moreover, one may use `ifeq (?,?)` make constructs to conditionally compile different things. Configuration tokens are usable.

Example:

```
objs = main.o

ifeq ($(CONFIG_SRL_SOCLIB),defined)
objs += barrier.o sched_wait.o srl_log.o hw_init.o
else
objs += posix_wait_cycles.o
endif

main.o_CFLAGS = -O0 -ggdb
```

The arch & cpu specific parts

Architecture and CPU directories have some special files which are injected in the building process:

- config.mk, included by make. It can define some compilation flags
- ldscript, invoked at link-time.
  - Architecture ldscript must create a loadable binary
  - CPU ldscript usually only specifies the entry point name

config.mk

The arch `config.mk` may override the following variables:

`ARCHCFLAGS`
: C-compiler flags

`ARCHLDFLAGS`
: Linker flags

`LD_NO_Q`
: Linker for the current architecture does not support -q switch, this slightly changes the linking process.

`HOSTCPPFLAGS`
: Flags to give to host's cpp (HOSTCPP) program. This is only used for expansion of `.def` files.

The cpu `config.mk` may override the following variables:

`CPUCFLAGS`
: C-compiler flags

`CPULDFLAGS`
: Linker flags

ldscript

Try `info ld` for a guide through ldscripts?

This ldscript is taken from architecture's object directory, thus it may be obtained from either:

- copy
- m4 processing
- cpp processing

See arch/emu/ldscript, arch/soclib/ldscript.m4, and arch/simple/ldscript.cpp for the three flavors !

Notes

Prerequisites

The MutekH build-system is based on GNU Make features. It makes intensive use of:

- includes
- $(foreach) $(subst) $(eval) $(call) macros
- macro definitions

Therefore, a Make-3.81 at least is mandatory.