QEMU Status Report

KVM Forum 2020

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2019 highlights

- Deprecated Python 2 support
- Kconfig integration
- “Fast boot” via PVH and mmap
- Introduced Sphinx for documentation

2019 highlights update

- Remove Python 2 support, follow Python 3 lifecycle
- Completed the conversion to Sphinx!

2020 highlights

- New targets (AVR, RX) and boards
- virtiofsd (virtio filesystem daemon)
- Improved CI
- Meson build system

Improved and consolidated CI

- Gitlab CI: main CI entry point + container registry
- Travis CI: various build combinations + non-x86 Linux
- Cirrus CI: non-Linux systems
  - FreeBSD, macOS, MSYS2
- OSS-Fuzz
- ~~Shippable~~
- Coverity (daily)

Plans for future CI

- Provide custom runners for Gitlab
- Patchew integration with Gitlab
- Phase out Travis further
- Identify further “holes” between Peter’s setup and CI

Technical debt

- Growth by accretion
- Limited documentation
- Few people knowing the details
- Limited interoperability

Technical debt

- Documentation
- QOM
- Build system

Documentation

- makeinfo, texi2pod + pod2man
  - Not used for developer documentation
  - Extensible with Make + shell
  - Manual build at release time
- Sphinx
  - kernel-doc integration
  - Extensible in Python (+ Perl for scripts/kernel-doc)
  - qemu.readthedocs.io

QOM

"I've started an effort to introduce a consistent object model to QEMU." – July 2011

"QOM provides a type system that lets ***objects*** expose ***properties*** to ***multiple channels***." – January 2020

QOM

- Easily accessible documentation
- Shorter boilerplate
- Easier “qdev” API

Meson build system

“The problem with programmers is that, when they have a problem, they start to program”

Meson build system

```
WL_U := -Wl,-u,
find-symbols = $(if $1, $(sort $(shell $(NM) -P -g $1 | $2)))
defined-symbols = $(call find-symbols,$1,awk '$$2!="U"{print $$1}')
undefined-symbols = $(call find-symbols,$1,awk '$$2=="U"{print $$1}')
process-archive-undefs = $(filter-out %.a %.mo,$1) \
                $(addprefix $(WL_U), \
                     $(filter $(call defined-symbols,$(filter %.a, $1)), \
                              $(call undefined-symbols,$(filter %.mo,$1)))) \
                $(filter %.a,$1)
extract-libs = $(strip $(foreach o,$(filter-out %.mo,$1),$($o-libs)))
LINK = $(call quiet-command, $(LINKPROG) $(CFLAGS) $(QEMU_LDFLAGS) -o $@ \
       $(call process-archive-undefs, $1) \
       $(version-obj-y) $(call extract-libs,$1) $(LIBS),"LINK","$(TARGET_DIR)$@")

expand-objs = $(strip $(sort $(filter %.o,$1)) \
                  $(foreach o,$(filter %.mo,$1),$($o-objs)) \
                  $(filter-out %.o %.mo,$1))
define save-vars
    $(foreach v,$1,
        $(eval save-vars-$v := $(value $v))
        $(eval saved-vars-$v := $(foreach o,$($v), \
            $(if $($o-cflags), $o-cflags $(eval save-vars-$o-cflags := $($o-cflags))$(eval $o-cflags := )) \
            $(if $($o-libs), $o-libs $(eval save-vars-$o-libs := $($o-libs))$(eval $o-libs := )) \
            $(if $($o-objs), $o-objs $(eval save-vars-$o-objs := $($o-objs))$(eval $o-objs := ))))
        $(eval $v := ))
endef
define load-vars
    $(eval $2-new-value := $(value $2))
    $(foreach v,$1,
        $(eval $v := $(value save-vars-$v))
        $(foreach o,$(saved-vars-$v),
            $(eval $o := $(save-vars-$o)) $(eval save-vars-$o := ))
        $(eval save-vars-$v := )
        $(eval saved-vars-$v := ))
    $(eval $2 := $(value $2) $($2-new-value))
endef
```

Meson build system

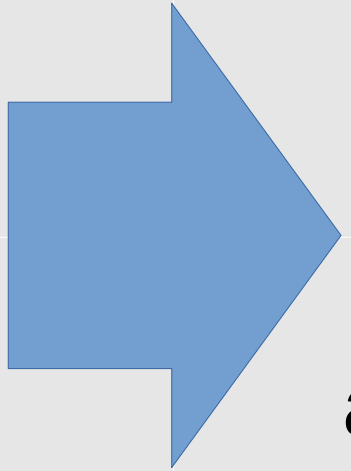
```
define fix-paths
    $(foreach v,$3,
        $(foreach o,$($v),
            $(if $($o-libs),
                $(eval $1$o-libs := $($o-libs)))
            $(if $($o-cflags),
                $(eval $1$o-cflags := $($o-cflags)))
            $(if $($o-objs),
                $(eval $1$o-objs := $(addprefix $1,$($o-objs)))))
        $(eval $v := $(addprefix $1,$(filter-out %/,$($v))) \
                     $(addprefix $2,$(filter %/,$($v)))))
endef
define unnest-var-recursive
    $(eval dirs := $(sort $(filter %/,$($3))))
    $(eval $3 := $(filter-out %/,$($3)))
    $(foreach d,$(dirs:%/=%),
            $(call save-vars,$2)
            $(eval obj := $(if $1,$1/)$d)
            $(eval -include $(SRC_PATH)/$d/Makefile.objs)
            $(call fix-paths,$(if $1,$1/)$d/,$d/,$2)
            $(call load-vars,$2,$3)
            $(call unnest-var-recursive,$1,$2,$3))
endef
define unnest-vars
    $(if $1,$(call fix-paths,$1/,,$2))
    $(foreach v, $2,
        $(call unnest-var-recursive,$1,$2,$v)
        $(foreach o, $(filter %.mo,$($v)),
            $(foreach p,$($o-objs),
                $(if $($o-cflags), $(eval $p-cflags += $($o-cflags)))
                $(if $($o-libs), $(eval $p-libs += $($o-libs))))))
    $(foreach v,$(filter %-y,$2),
        $(eval $v := $(foreach o,$($v),$(if $($o-objs),$($o-objs),$o))))
    $(foreach v,$(filter %-m,$2),
        $(foreach o,$(filter %.o,$($v)),
            $(eval $(o:%.o=%.mo)-objs := $o))
        $(eval $v := $($v:%.o=%.mo))
        $(eval modules-m += $($v))
        $(if $(CONFIG_MODULES),
             $(foreach o,$($v),
                   $(eval $($o-objs): CFLAGS += $(DSO_OBJ_CFLAGS))
                   $(eval $o: $($o-objs)))
             $(eval $(patsubst %-m,%-y,$v) += $($v))
             $(eval modules: $($v:%.mo=%$(DSOSUF))),
             $(eval $(patsubst %-m,%-y,$v) += $(call expand-objs, $($v)))))
    $(foreach v,$2,
        $(foreach o, $(filter %.mo,$($v)),
            $(if $($o-objs),
                $(eval $(o:%.mo=%$(DSOSUF)): module-common.o $($o-objs)),
                $(error $o added in $v but $o-objs is not set)))
        $(shell mkdir -p ./ $(sort $(dir $($v))))
        $(eval -include $(patsubst %.o,%.d,$(patsubst %.mo,%.d,$($v))))
        $(eval $v := $(filter-out %/,$($v))))
endef
```

Meson build system

- Building QEMU is a stream
  - Each file should only be read once
  - Gather data, then process it
- Cannot convert everything at once
  - Establish the foundation ✓
  - Start with the low-hanging fruit ✓
  - Everything else can come in later
- Work with Meson upstream

Meson build system

Shell + Make	Non Turing-complete DSL
POSIX shell	Commands as arrays of strings
(Trying to be) declarative	Imperative (but no aliasing or mutability)
Strings	Strings, arrays, dictionaries



Meson build system

Before:

```
 8647 configure
 1296 Makefile
  985 tests/Makefile.include
  440 rules.mak
  397 default-configs/*
  287 Makefile.target
  215 Makefile.objs
   97 {qapi,trace}/Makefile.objs
  129 scripts/create_config
-------------------------------
12493 total
```

After:

```
 7289 configure
 1989 meson.build
  655 default-configs/*/*
  542 tests/{,qtest/}meson.build
  264 Makefile
  158 tests/Makefile.include
  223 {qapi,trace}/meson.build
   69 docs/meson.build
-1008 scripts/ninjatool.py
  130 scripts/mtest2make.py
   49 scripts/undefsym.py
-------------------------------
11364 total
```

Hall of Fame

Google Summer of Code + Outreachy

3 projects accepted, passed and merged!

- César Belley: Virtual FIDO/U2F security key
- Filip Božuta: Extend linux-user syscalls and ioctls
- Ahmed Karaman: TCG Continuous Benchmarking

Shoutouts

- Thomas Huth and Alex Bennée: CI
- Markus Armbruster, Daniel Berrangé, Eduardo Habkost: QOM and qdev refactoring
- Eduardo Habkost, Peter Maydell: documentation
- Richard Henderson: all things TCG and more
- Laurent Vivier, Philippe Mathieu-Daudé: hobbyist spirit
- Peter Maydell: merging everything

What’s next?

More gitlab?

- Static site generation
- Primary repository
- Release process
- Issue tracking
- Wiki

Rethinking the QEMU API

- "Making QEMU easier for management tools and applications" (Stefan Hajnoczi + 179 more messages over 1.5 months)
- “QEMU has 131 command line flags.” (John Snow)
  - More API, less command line!
  - Embrace QMP for configuration, extending -preconfig
- “Official” bindings for QAPI through code generation

Multiprocess QEMU (and Rust-y QEMU)

- vhost-user servers with qemu-storage-daemon
- Possibly vfio-user?
- “Why QEMU should move from C to Rust “ (Stefan again!)
  - “Learning Rust is humanly possible, writing bug-free C code is not.”
- Looking at integration of QAPI with Rust

Thank you

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