Know your QEMU and KVM test frameworks

KVM Forum 2021

Thomas Huth <thuth@redhat.com>

2021-09-15
Introduction

• The KVM / QEMU virtualization stack is rather huge and complex

• There are many different test frameworks which might be good to know:
  – KVM selftests
  – kvm-unit-tests
  – QEMU test suites
  – Avocado-based tests
  – ...

KVM selftests
KVM selftests

- C framework for testing the KVM ioctl API
- Resides in the Linux kernel git tree (see tools/testing/selftests/kvm/ folder)
- Library functions for creating VMs & vCPUs
- No QEMU involved
- ELF loader for using the same program in the guest
static void guest_code(void)
{
    uint64_t cr4 = get_cr4();
    cr4 |= X86_CR4_OXSSAVE; set_cr4(cr4);
    GUEST_ASSERT(cr4_cpuid_is_sync());
    GUEST_SYNC(0);
    GUEST_DONE();
}

int main(int argc, char *argv[])
{
    /* Create VM */
    vm = vm_create_default(VCPU_ID, 0, guest_code);
    run = vcpu_state(vm, VCPU_ID);

    while (1) {
        rc = _vcpu_run(vm, VCPU_ID);
        ...
    }

    kvm_vm_free(vm);
}
kvm-unit-tests
kvm-unit-tests

- A test framework almost as old as KVM
- Low-level CPU & device tests using QEMU
- Guest code is compiled as standalone binary and run via the “-kernel” option
- Has a simple libc and other libs for the guest
- Website:
  https://gitlab.com/kvm-unit-tests/kvm-unit-tests
  http://www.linux-kvm.org/page/KVM-unit-tests
Using the kvm-unit-tests

- git clone https://gitlab.com/kvm-unit-tests/kvm-unit-tests.git
- Run the “configure” script and “make” (Use “--arch=...” for different targets)
- run_tests.sh script runs all tests as defined in the .../unitests.cfg file
- qemu-system-x86_64 -serial stdio \ -accel kvm -kernel x86/sieve.flat \ -device isa-debug-exit,iobase=0xf4,iosize=0x4
kvm-unit-tests demo
Tests in the QEMU repository
QEMU tests

- Multiple test suites in the QEMU repo
- Get some help with: `make check-help`
- Run most in one go with: `make check`
QEMU unit tests

- See tests/unit/ folder
- Language: C
- “Classical” unit tests, link test code with code from the QEMU binaries
- Mainly used to test the functions from the util/ folder (but also some others)
- Compile & run with: make check-unit
QEMU unit tests demo
QEMU iotests

- See tests/qemu-iotests/ folder
- Languages: bash and Python
- A big mixed bag with various scripts that test the block layer of QEMU
- Run subset with:
  make check-block
or more tests with:
  cd tests/qemu-iotests/
  ./check -qcows2 ...
QEMU iotests demo
QEMU qtests

- See tests/qtest/ in the QEMU repo
- Language: C
- Framework to exercise devices in QEMU
- Runs QEMU with the CPU replaced by the “qtest accelerator”
- Tests can read/write guest memory, trigger IRQs, step the clock, etc.
QEMU normal run

CPU → memory → devices

guest

qemu binary
QEMU qtest run

Test code

qtest binary

qemu binary

qtest accel

memory

devices

guest
QEMU qtest demo
QEMU avocado tests

- See tests/acceptance/ folder
- Language: Python
- Download Linux and other test kernel blobs from the internet
- Check that the kernels are behaving right when running in QEMU
- Run with: make check-acceptance (not part of “make check”)

QEMU avocado tests demo
Other QEMU tests

• More test suites in the QEMU repository:
  – Benchmark / performance tests
  – QAPI schema tests
  – FPU softloat tests
  – TCG (guest CPU instruction) tests
  – Decodetree tests

• More external test suites like avocado-vt
• No time for these today (sorry!)
Thanks for your attention!