Introduction of virtio crypto device

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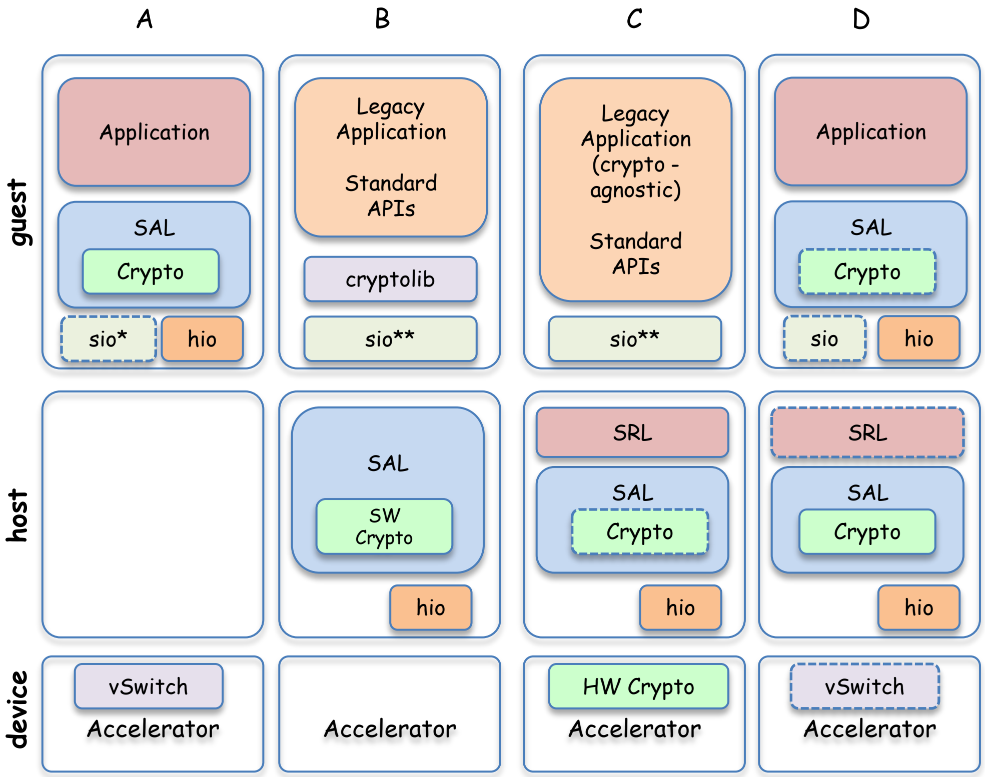
Agenda

- Crypto use cases
- Crypto in Linux
- Overview of virtio-crypto
- Performance
- Status of virtio-crypto

Crypto use cases (VNF Acceleration)



* Standard VirtIO and Kernel based vHost, Kernel layer not shown

** Standard or enhanced VirtIO to vHost-user in the SAL

Showing a number of possible options:

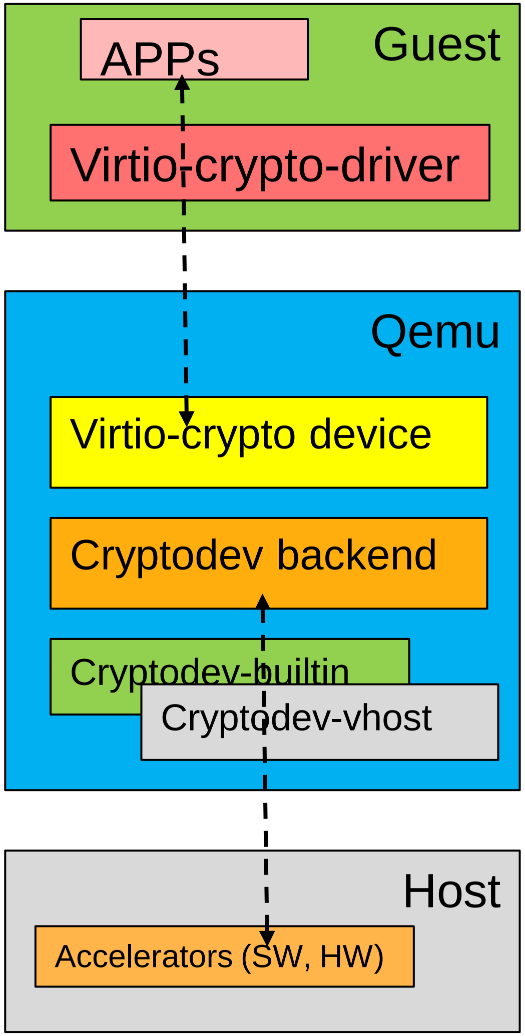
- Example A (non-hio packets have poor performance)
  - VM with a SAL for direct access to external device
  - The sio is optional for host access for management
  - VM to VM support only supplied by vSwitch or external device
- **Example B**
  - **Legacy application using crypto lib via VirtIO to accelerate crypto operations in the host**
  - VM to VM still missing, but can be supported by SAL to external vSwitch accelerator
- **Example C**
  - **Legacy application being agnostic to the encrypted traffic being handled in the host/accelerator**
  - Adding a SRL (vSwitch/vRouter) for VM to VM communication
- **Example D**
  - **Accelerated application using SAL in guest to access crypto accelerator directly**
  - Flexible vSwitch or vRouter support in SW or HW
  - SAL allows for some/all crypto operations to be done in the guest on passed to the host for processing

Note: The slide is picked up from “DPACC : Platform Performance Acceleration Session” Keith Wiles (Intel) & Bob Monkman (ARM)

Crypto in Linux

- A cryptography framework in the Linux kernel
- Can do Cipher, Hash, Compress, RNG,. . .
- Can register supported algorithms for hardware crypto accelerators
- Used by:
  - ✓ Network stack: IPsec, . . .
  - ✓ Device Mapper: dm-crypt, RAID, . . .
  - ✓ Userland Accessing:
    - ✓AF_ALG (in-kernel, socket-based API)
    - ✓Cryptodev (Out-of-kernel tree code for years)
- Maillist: linux-crypto@vger.kernel.org

Overview of virtio-crypto



- **Host emulate virtio-crypto device for the Guest**
- **Host add cryptodev backend object for Virtio-crypto device**
- Cryptodev backend object can be realized to different child objects, like:
  - cryptodev-backend-builtin
  - cryptodev-vhost (vhost-user and/or vhost-kernel)
- **Guest install virtio-crypto driver**
  - user space: virtio-crypto pmd driver for DPDK/ODP
  - kernel space: adapt to Linux Crypto Framework

Cryptodev backend

- An user creatable object in QEMU

  cmds: -object/object-add/object_add

  Example:

  ```
  #./qemu-system-x86_64 -object cryptodev-backend,id=cy0
  ```

- Can be realized with different child objects
- Key code:

```
static const TypeInfo cryptodev_backend_info = {
    .name = TYPE_CRYPTODEV_BACKEND,
    .parent = TYPE_OBJECT,
    .instance_size = sizeof(CryptoDevBackend),
    .instance_init = cryptodev_backend_instance_init,
    .instance_finalize = cryptodev_backend_finalize,
    .class_size = sizeof(CryptoDevBackendClass),
    .class_init = cryptodev_backend_class_init,
    .interfaces = (InterfaceInfo[]) {
        { TYPE_USER_CREATABLE },
        { }
    }
```

Cryptodev backend builtin

- A cryptodev backend child
- Realized with QEMU cipher APIs
- Support nettle、gcrypt or cipher-buitlin in QEMU
- Limited algorithms, Only few Cipher algorithms currently
- Software acceleration
- Poor performance
- Should not be used in production environment
- Examples:

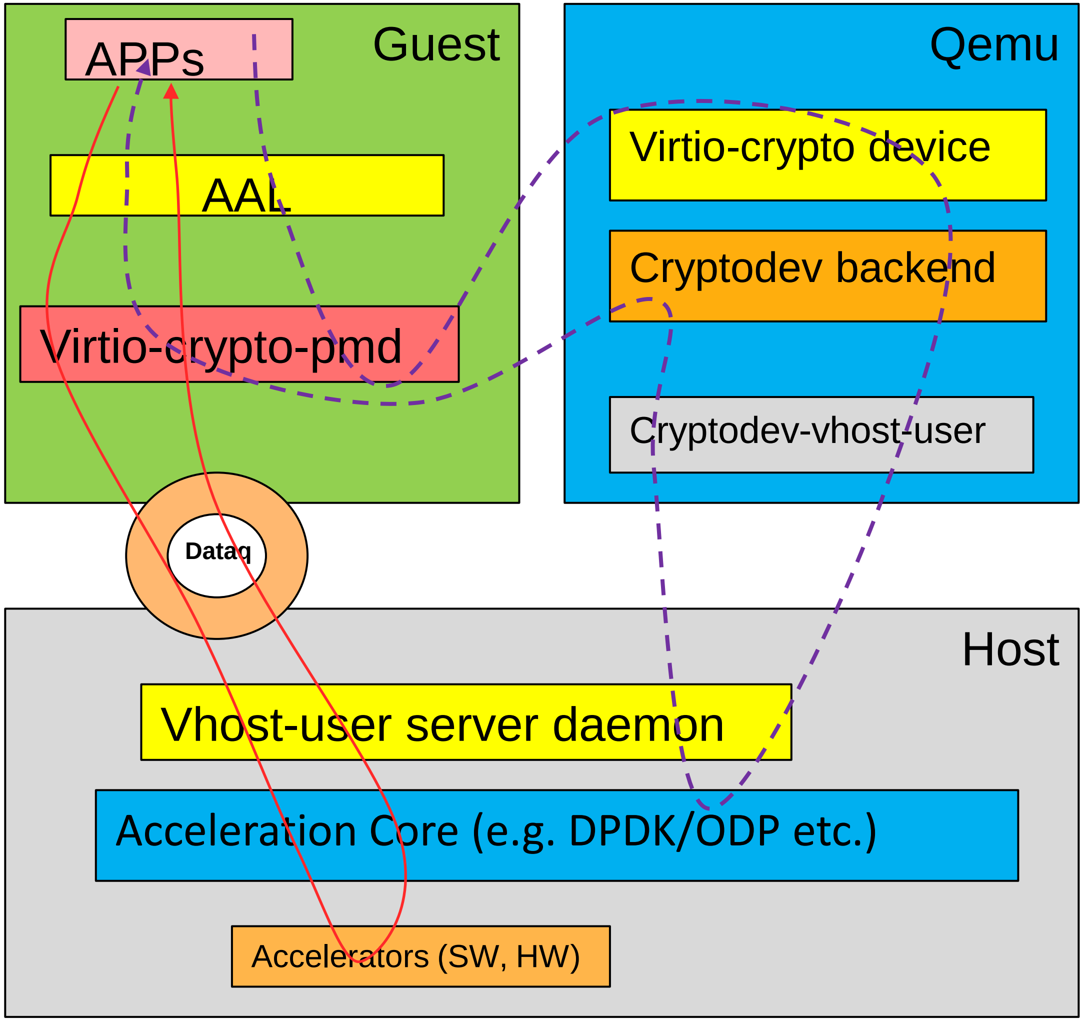
```
# qemu-system-x86_64 \
[...] \
    -object cryptodev-backend-builtin,id=cryptodev0 \
    -device virtio-crypto-pci,id=crypto0,cryptodev=cryptodev0 \
[...]
```

Cryptodev backend vhost-user

- Another cryptodev backend child
- More algorithms supported
- Software and/or Hardware acceleration
- Can use high performance software framework, such as DPDK.
- Support multiple queues
- Good performance, can be used in production environment
- Examples:

```
# qemu-system-x86_64 \
[...] \
    -chardev socket,id=charcrypto0,path=/your/path/socket0
    -object cryptodev-vhost-user,id=cryptodev0 ,chardev=charcrypto0\
    -device virtio-crypto-pci,id=crypto0,cryptodev=cryptodev0 \
[...]
```

Cryptodev-vhost-user architecture



- AAL:
  - Acceleration Abstract Layer
- Dashed Line:
  - flow of control virtqueue
  - Need to trap into QEMU and communicate with vhost-user server
- Full Line:
  - flow of data virtqueue
  - Do not need pass QEMU
- Acceleration Core
  - e.g. DPDK, ODP or other acceleration implementation
- Virtio-crypto-pmd
  - User space driver for virtio-crypto device, e.g. the poll mode driver in DPDK.
- Vhost-user server dameon
  - Create the socket communicated with QEMU
  - Invoke AC crypto APIs

Virtio crypto device design

- A virtual crypto device as well as a kind of virtual hardware accelerator for virtual machines
- Include data virtqueue and control virtqueue
  - **Control virtuqueue:** create or destroy sessions for sym algos, …
  - **Data virtuqueue:** crypto requests transmition in data plane
- Support the following crypto services currently: CIPHER, MAC, HASH, AEAD
- Support multiple virtual data queues
- Follow the virtio-1.0 specification
- Virito device ID: 20
- Virtio PCI device ID: 0x1054 (= 0x1040 + 20)

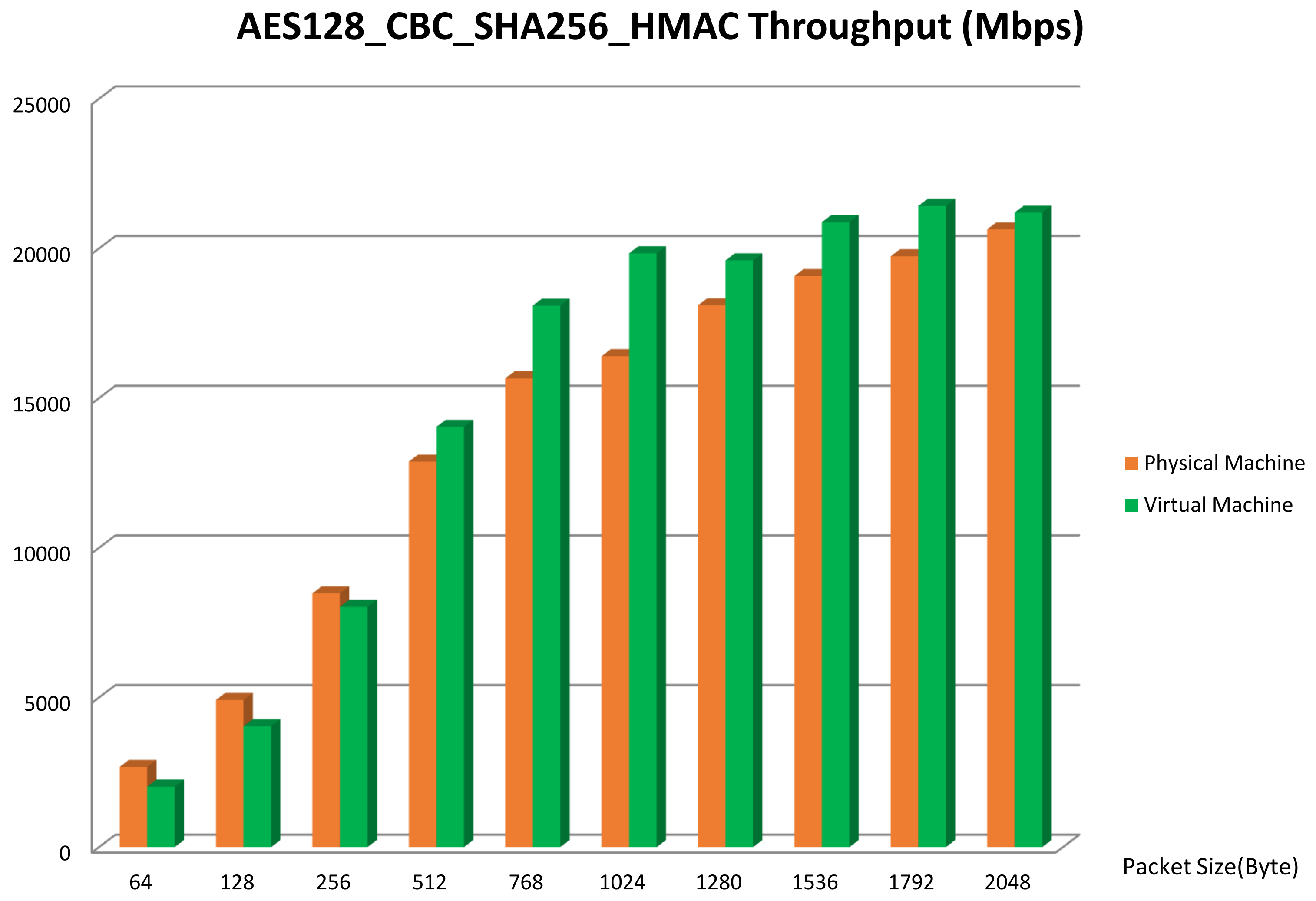
Performance - configuration

- **Hardware**
  1) Server: HUAWEI RH2288H V3
  2) CPU: Intel(R) Xeon(R) CPU E5-2620 v3 @ 2.40GHz
  3) Intel QAT Coleto Creek PCIe DH895xCC SKU2
- **Software**
  1) Host: UVP-V200R002C00SPC300B062
  2) Guest: Suse11.3 with 8 GB memory, 4vcpu

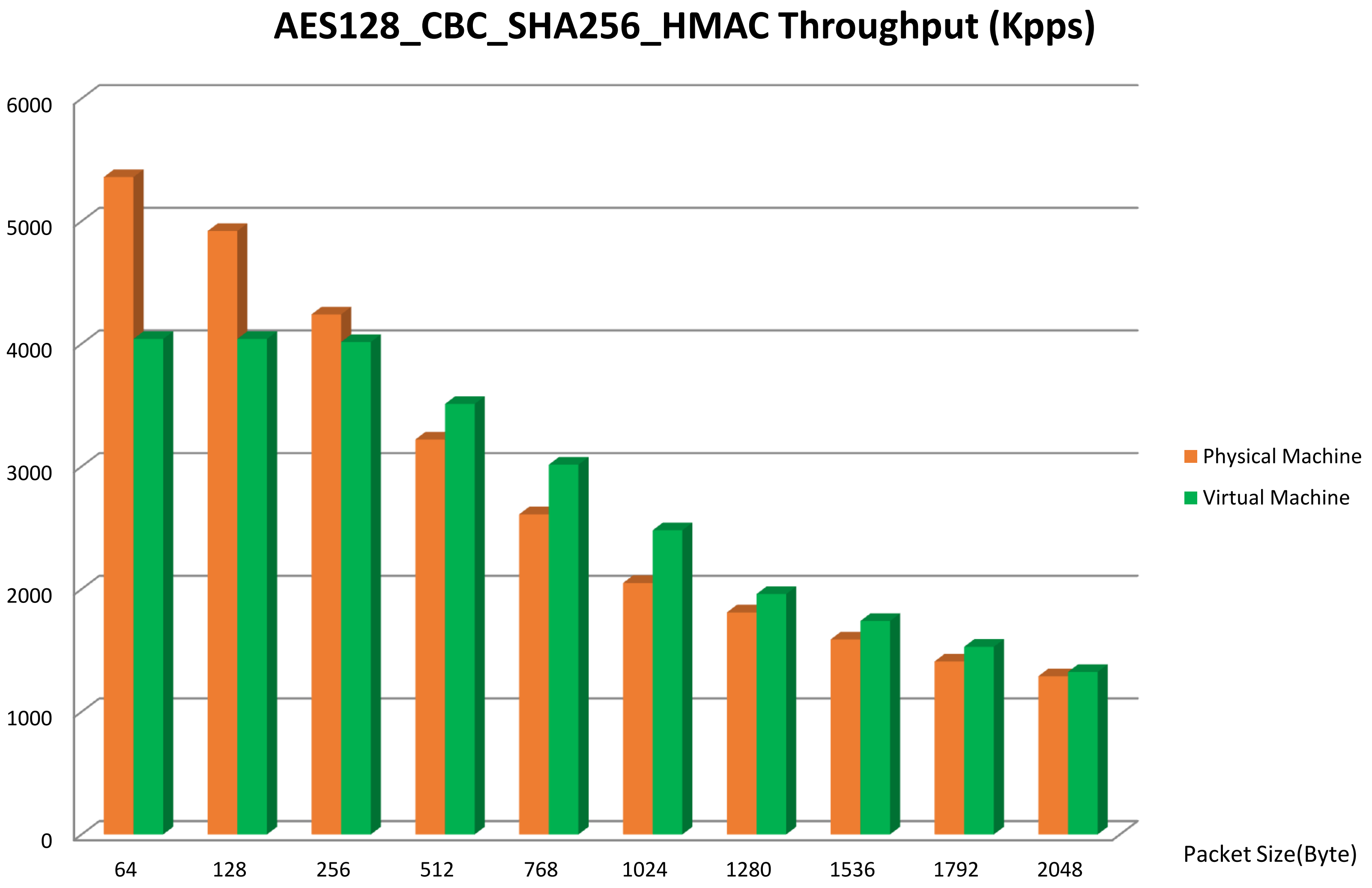
Numa Info	available: 2 nodes (0-1) node 0 cpus: 0 1 2 3 4 5 12 13 14 15 16 17 node 0 size: 65141 MB node 0 free: 61013 MB node 1 cpus: 6 7 8 9 10 11 18 19 20 21 22 23 node 1 size: 65536 MB node 1 free: 11251 MB node distances: node 0 1 0: 10 21 1: 21 10

```
<vcpu placement='static'>4</vcpu>
 <cputune>
   <vcpupin vcpu='0' cpuset='10'/>
   <vcpupin vcpu='1' cpuset='22'/>
   <vcpupin vcpu='2' cpuset='11'/>
   <vcpupin vcpu='3' cpuset='23'/>
   <emulatorpin cpuset='10-11,22-23'/>
 </cputune>
```

Performance



Performance



Status of virtio-crypto's patches

Virtio and DPDK	Host	Guest
🟩 Virtio crypto specification	🟩 QEMU -device virtio-crypto	🟨 virtio-crypto-pmd
🟨 Vhost-user-crypto based on DPDK	🟩 QEMU -object cryptodev-backend-builtin	🟩 Virtio-crypto Linux Kernel Driver
	🟨 QEMU -object cryptodev-vhost-user	⬜ Support more algorithms, live migration etc.

🟨 Patches not yet posted

🟩 Patches not yet merged

⬜ Not yet implemented

Questions?

- Email:
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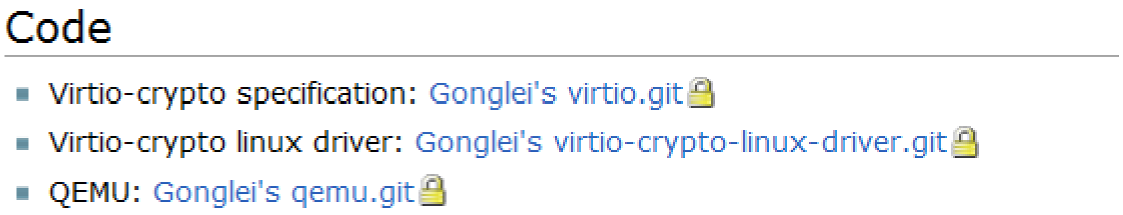
  - arei.gonglei@hotmail.com
- For information about virtio-crypto:

  http://qemu-project.org/Features/VirtioCrypto



Code

- Virtio-crypto specification: Gonglei's virtio.git
- Virtio-crypto linux driver: Gonglei's virtio-crypto-linux-driver.git
- QEMU: Gonglei's qemu.git

Thank you

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