LiveBackup

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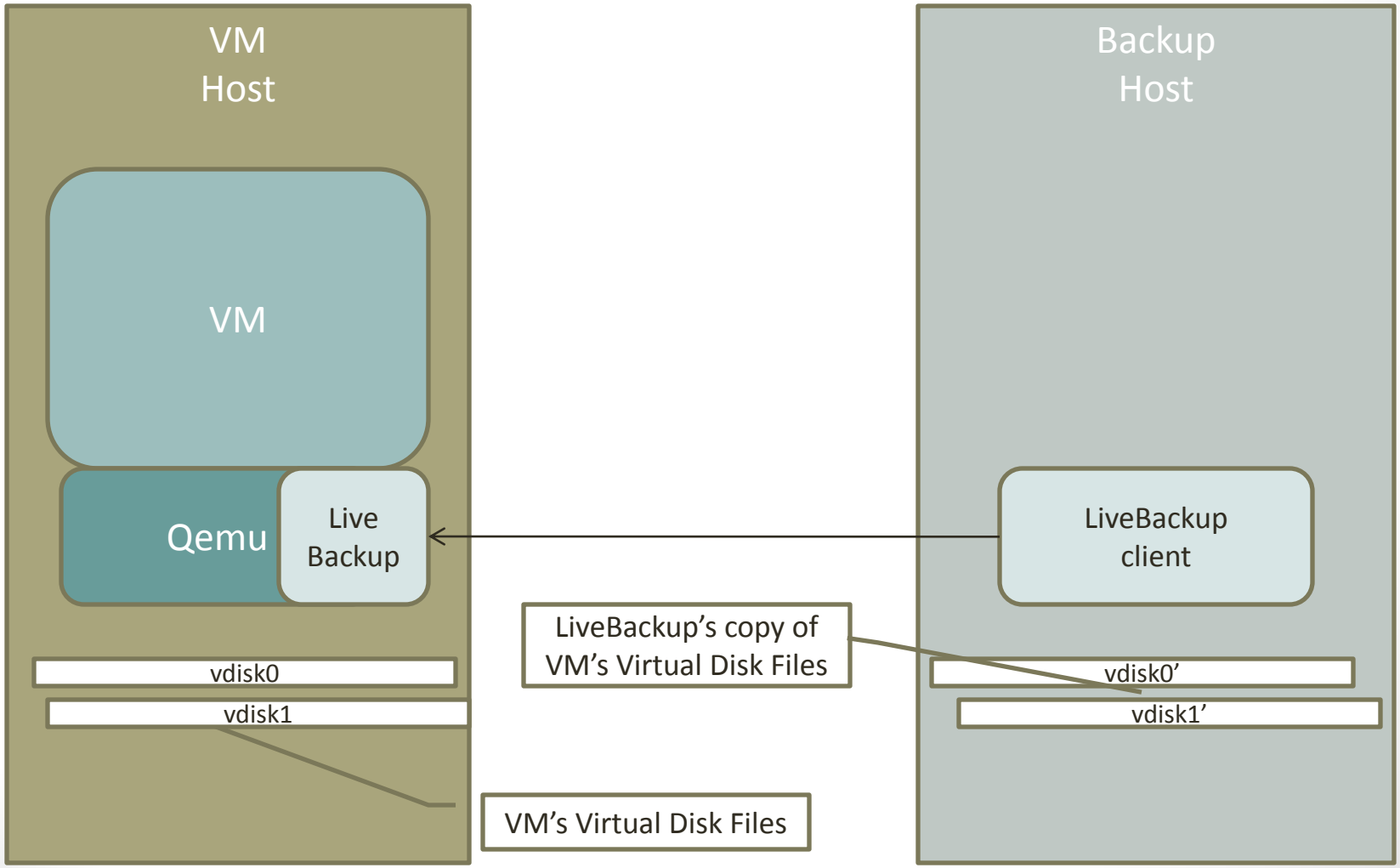
LiveBackup
A complete Backup Solution

- Create Full and Incremental Backups of running VMs
- A System Administrator or Backup Software can use livebackup_client to connect to the qemu process using a TCP socket and transfer dirty blocks over
- Once dirty blocks are transferred over:
  - They can be saved in an incremental backup file and written to tape, or
  - The dirty blocks can be applied to a full backup image and kept ready to restart the VM on the backup host

LiveBackup - Overview



LiveBackup
Design Principles

- Designed for cloud operator needs
- Must have minimal performance impact on the running VM while it is in normal operation
- Must work with all types of virtual disk types, qcow, qcow2, LVM volumes, etc.
- Under failure circumstances, the operation of the VM must not be impaired (the backup operation can be sacrificed, but the VM must continue to operate just fine)
- Extra disk requirements should not be onerous

LiveBackup
A Complete Backup Solution

- Solution consists of:
  - Functional improvements to the qemu block layer:
    - Track dirty blocks in memory since last full backup. Persist this across VM reboots
    - A custom network protocol to transfer dirty disk blocks (will possibly be replaced by enhancements to libvirt)
    - A snapshot mechanism to maintain a snapshot while the backup client transfers the dirty blocks over to the backup server
  - livebackup_client to transfer dirty blocks from qemu

LiveBackup Characteristics

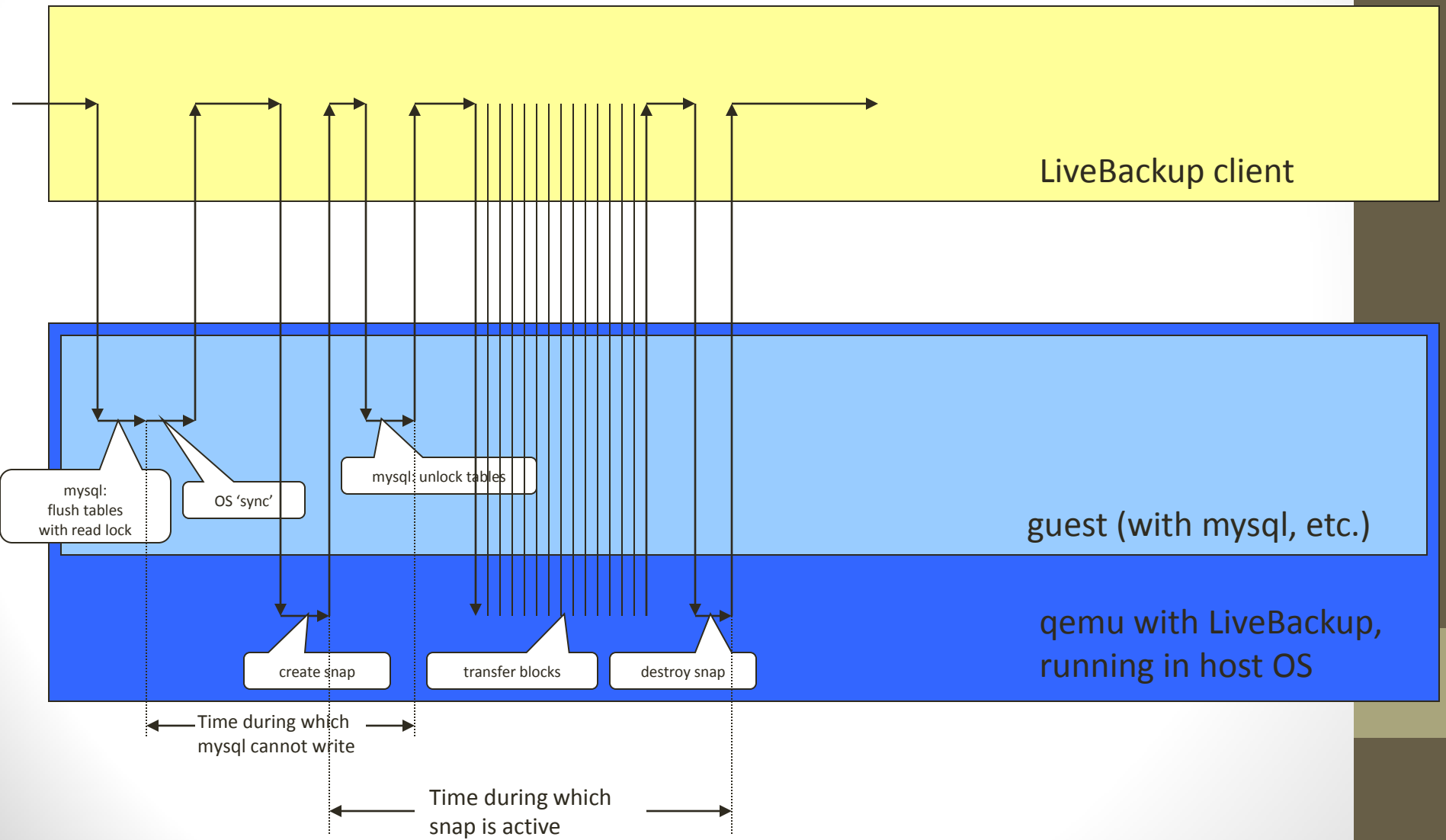
- Most of the time, i.e. when a livebackup_client is not connected to qemu, LiveBackup merely sets a bit in the in-memory bitmap indicating that the block has been ‘dirtied’

- When a backup client wants to take a backup, it will to create a point-in-time snapshot of all the virtual disks, usually after inducing the Application and Guest OS to flush buffered data

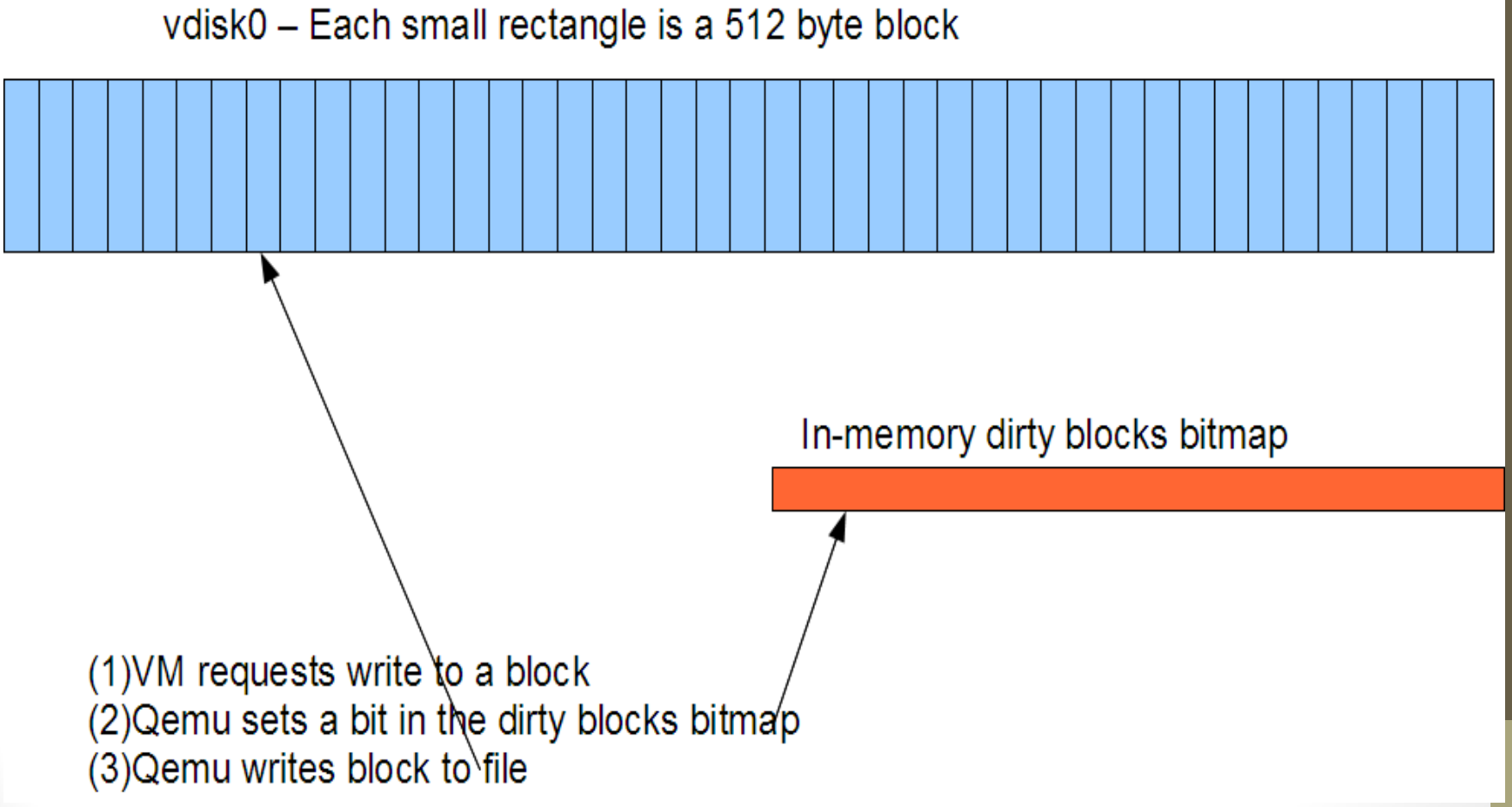
LiveBackup Example
Backup a VM that uses mysql

- ssh into guest OS and run mysql command:
  - 'flush tables with read lock'
- Run 'sync' on guest OS to flush blocks (wait for a few seconds)
- Connect to qemu livebackup and call 'create snapshot'
- ssh into guest OS and run mysql command:
  - 'unlock tables'
- Connect to qemu livebackup and copy blocks for snapshot (all blocks for full backup, just dirty blocks for incremental backup)
- Connect to qemu livebackup and call 'destroy snapshot'

Timeline of backup operation

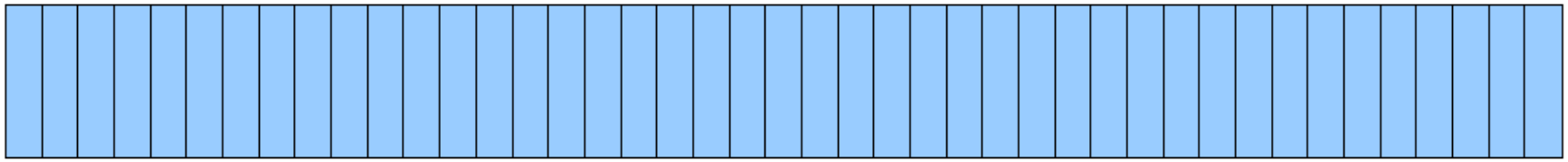


Livebackup – Normal operation



Livebackup – livebackup_client calls snapshot

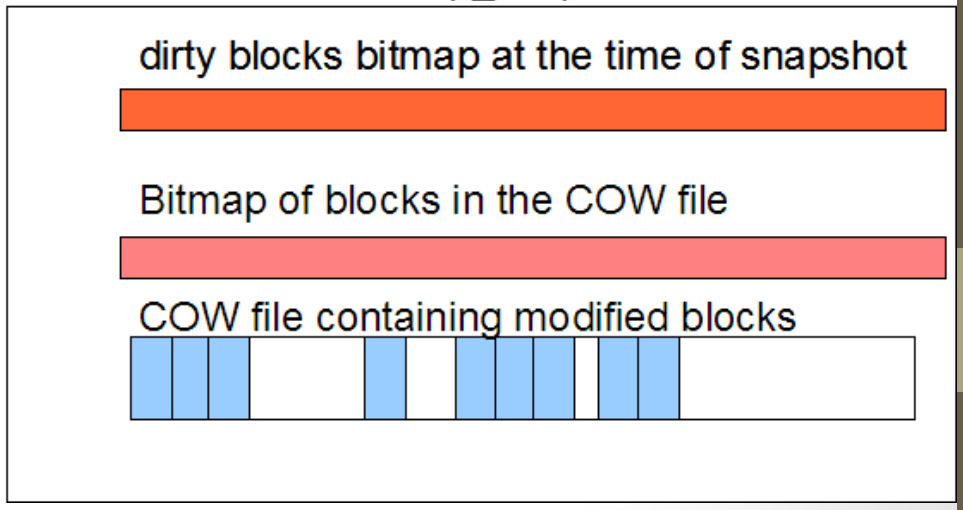
vdisk0 – Each small rectangle is a 512 byte block



- livebackup_client connects to qemu and asks for snapshot
- Qemu moves existing dirty blocks bitmap to livebackup_snapshot struct (only one snapshot can exist)
- Qemu allocates new dirty blocks bitmap

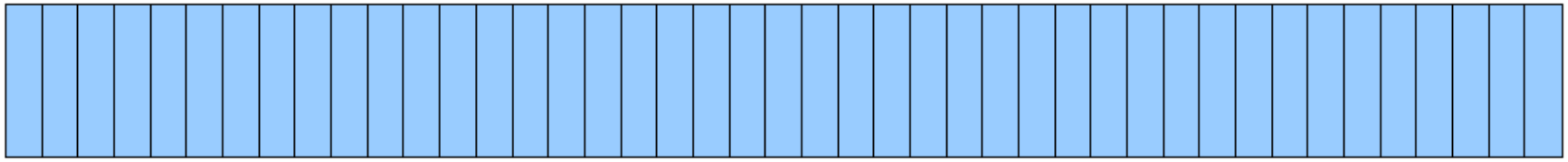
In-memory dirty blocks bitmap

Struct livebackup_snapshot



Livebackup – livebackup_client runs backup

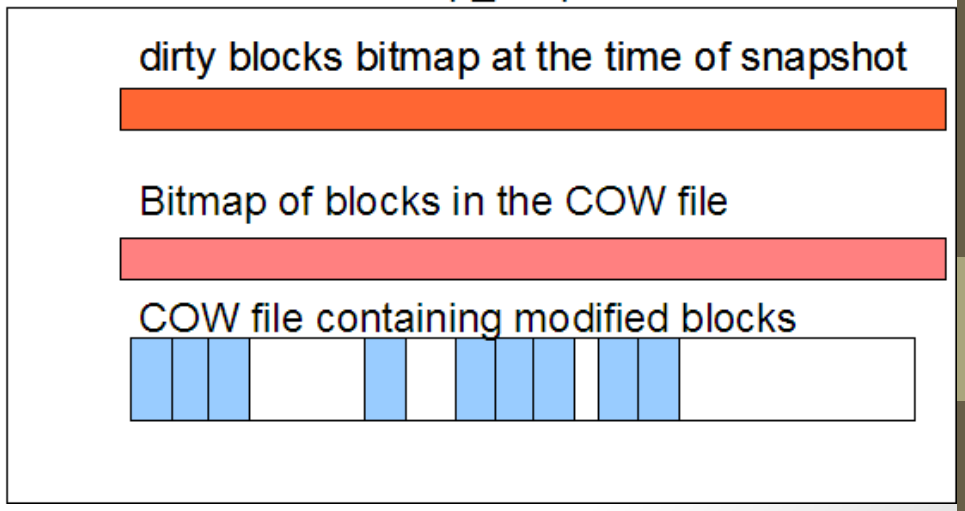
vdisk0 – Each small rectangle is a 512 byte block



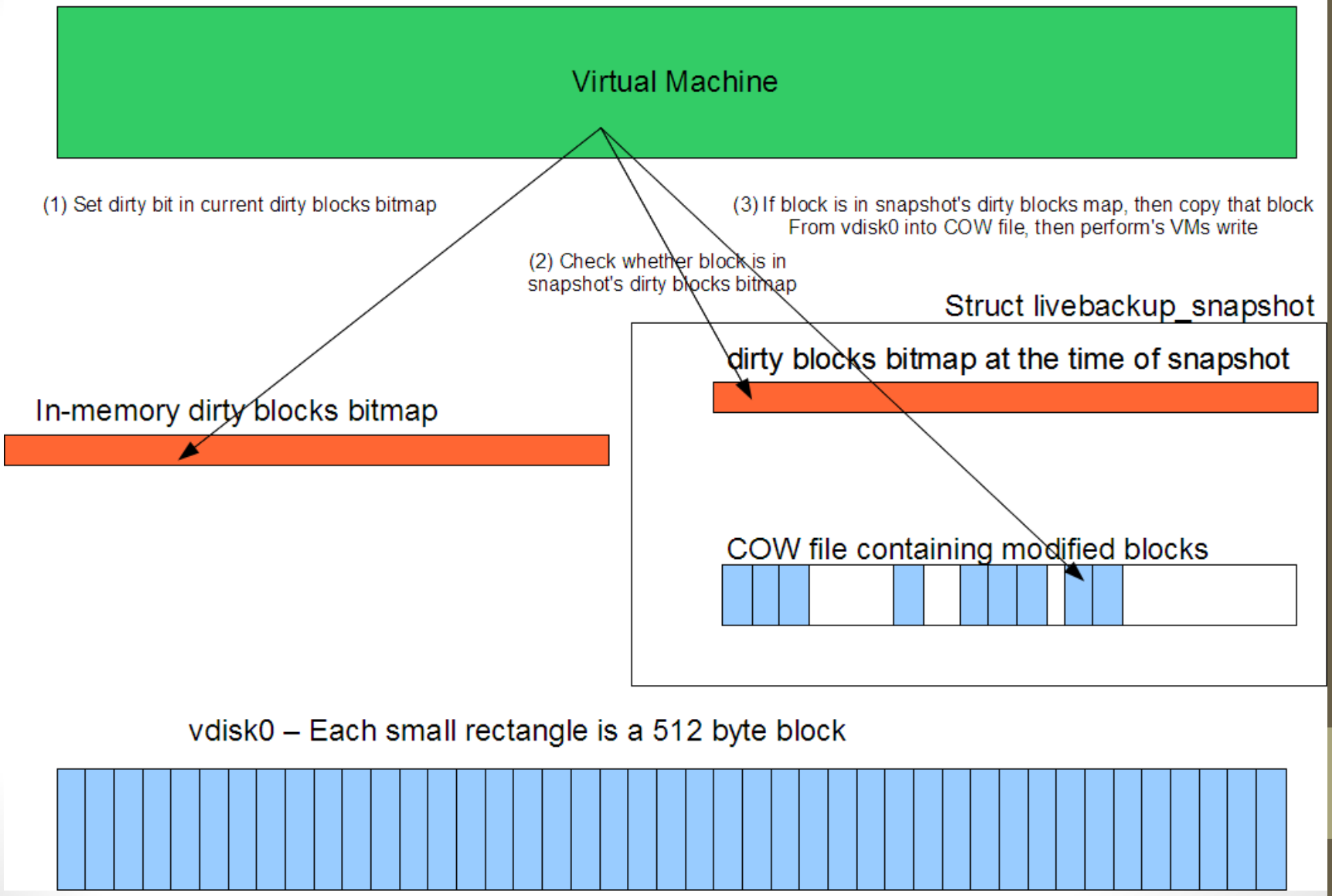
- VM calls qemu to write block(s)
- livebackup_interposer checks if any of these blocks are marked dirty in livebackup_snapshot's dirty bitmap
- If so, the blocks that are going to be overwritten are read in and saved to the COW file in the livebackup_snapshot. Then the VM's write is allowed to proceed
- In the meantime, livebackup_client is busy copying the blocks marked dirty in livebackup_snapshot over the network. The COW file in the livebackup_snapshot is checked for dirty blocks before reading from the base file

In-memory dirty blocks bitmap

Struct livebackup_snapshot



Livebackup – VM write while livebackup_client runs backup



Usage Example

Livebackup Server (built into qemu process for the VM)

```
# ./x86_64-softmmu/qemu-system-x86_64 \
-drive file=/dev/kvm_vol_group/kvm_root_part,boot=on,if=virtio,livebackup=on \
-drive file=/dev/kvm_vol_group/kvm_disk1,if=virtio,livebackup=on \
-vnc 0.0.0.0:1000 -usb -usbdevice tablet \
-livebackup_dir /root/kvm/livebackup
-livebackup_port 7900 \
-m 512 -net nic,model=virtio,macaddr=52:54:00:00:00:01 \
-net tap,ifname=tap0,script=no,downscript=no
```

Livebackup Client (run on backup server)

```
# livebackup_client /root/kvm-backup 192.168.1.220 7900
```

LiveBackup
Failure Scenarios

- **qemu crashes during normal operation of the VM**
  - livebackup_client is forced to do a full backup the next time around
- **qemu crashes while livebackup is in progress**
  - livebackup_client is forced to do a full backup the next time around
- **livebackup_client crashes while livebackup is in progress**
  - a new livebackup_client can redo the last type of backup it was doing - an incremental backup or a full backup

In most failure scenarios, the backup is impacted, but the VM itself continues to run unimpaired

LiveBackup
Testing methodology

Hypothesis: LiveBackup creates a backup of all the virtual disks of a VM such that the backup virtual disk images will be a bit for bit match of the virtual disk images at the point in time when the livebackup_client program issues a 'create snapshot' command

- I added code to my implementation of do_snap in livebackup.c, such that after the livebackup snapshot is created, I would invoke lvcreate to create a LVM snapshot of the underlying LVM logical volume
  - *# /sbin/lvcreate -L1G -s -n kvm_root_part_backup /dev/kvm_vol_group/kvm_root_part*
- Run the livebackup_client on the same machine as the VM to create a backup image of the virtual disks
- Run 'cmp' to compare the backup disk image file and the snapshot logical volume created
  - *# cmp /dev/kvm_vol_group/kvm_root_part_backup kvm_root_part*

Git repositories

- git://github.com/jagane/qemu-livebackup.git
- git://github.com/jagane/qemu-kvm-livebackup.git

LiveBackup

Thank You

Question? Comments? Flames?

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