oVirt

Thanks for Live Snapshots, Where's Live Merge?

KVM Forum
16 October 2014

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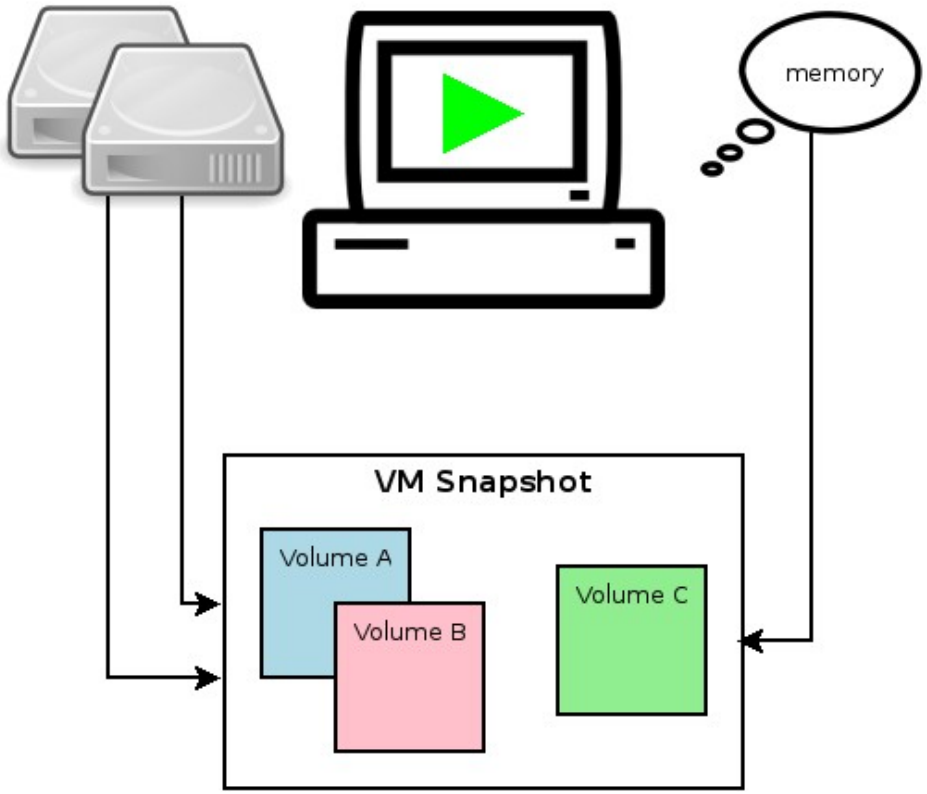
Agenda

oVirt

- Introduction of Live Snapshots and Live Merge
- Managing Live Merge for Reliability and Simplicity
- Future work

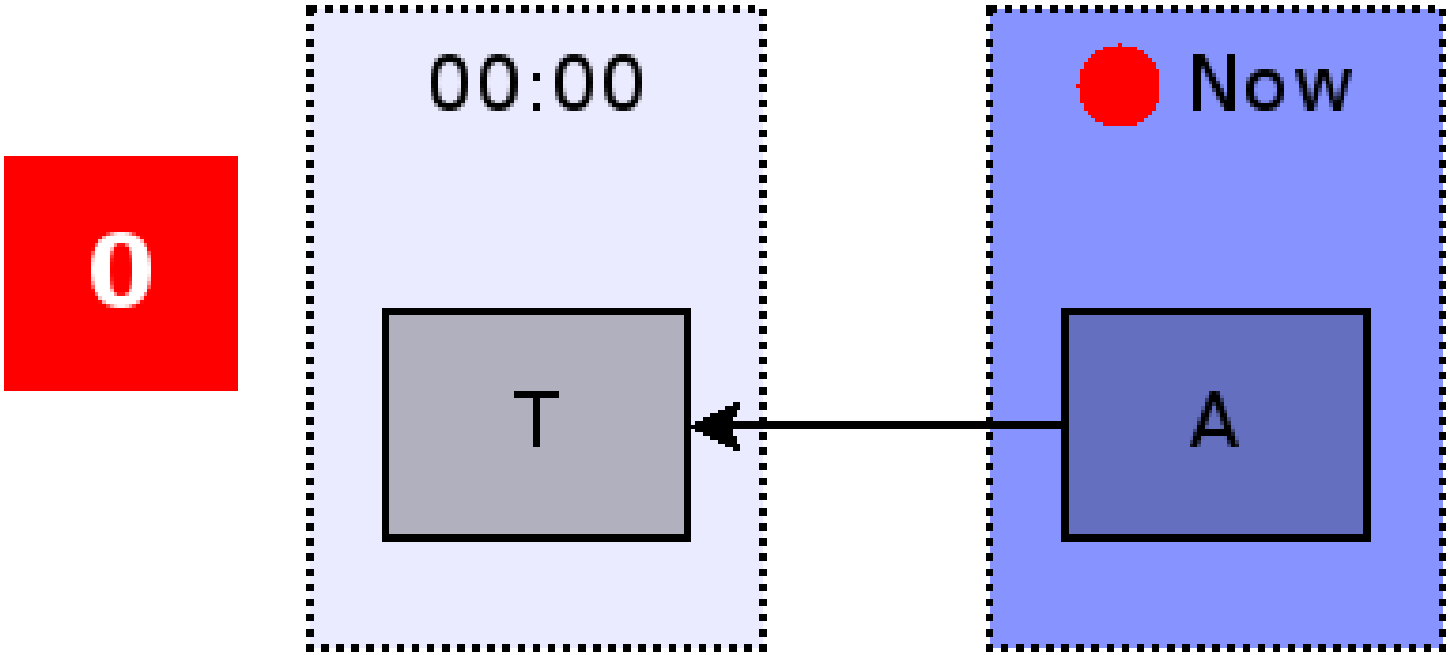
Introduction of Live Snapshots and Live Merge

Live snapshots



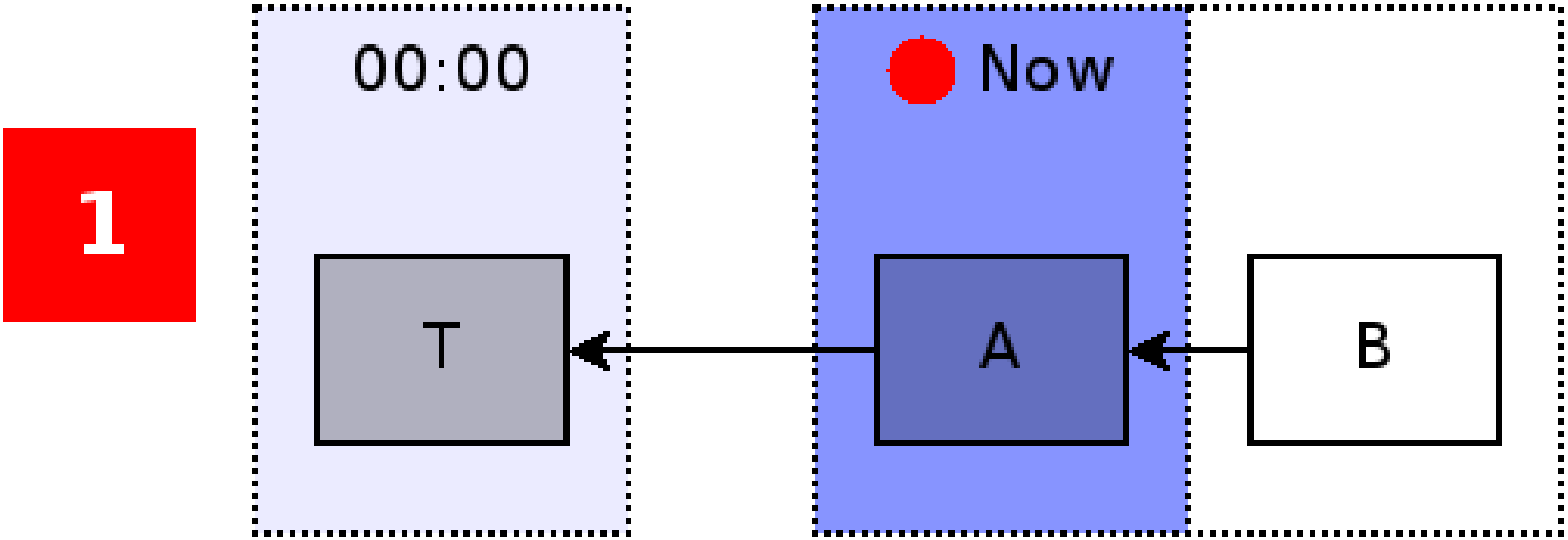
- Capture disks and memory at a point in time
- Implemented using qcow2 volume chains
- Uses
  - Preview or revert
  - VM live backup
  - Live storage migration

Creating a live snapshot of a disk



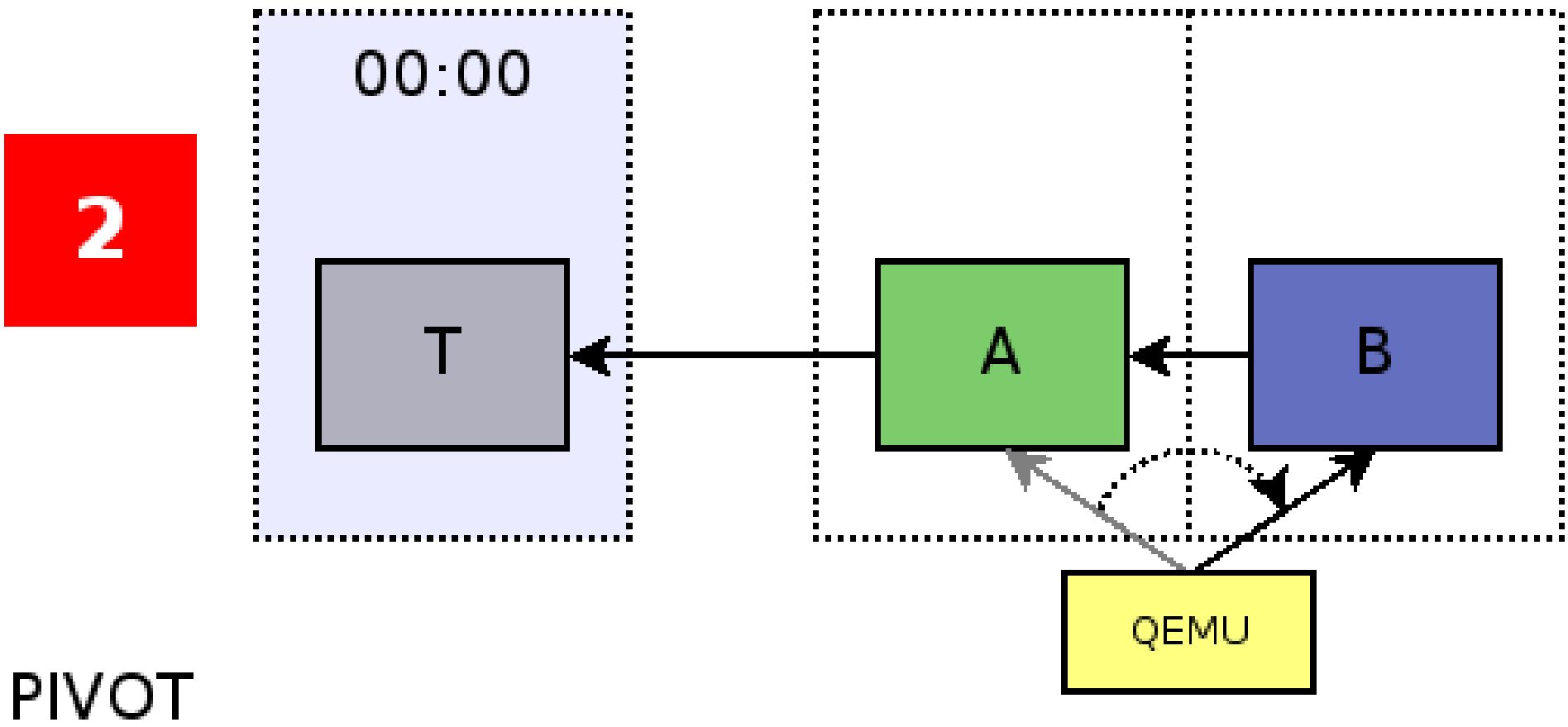
INITIAL STATE

Creating a live snapshot of a disk

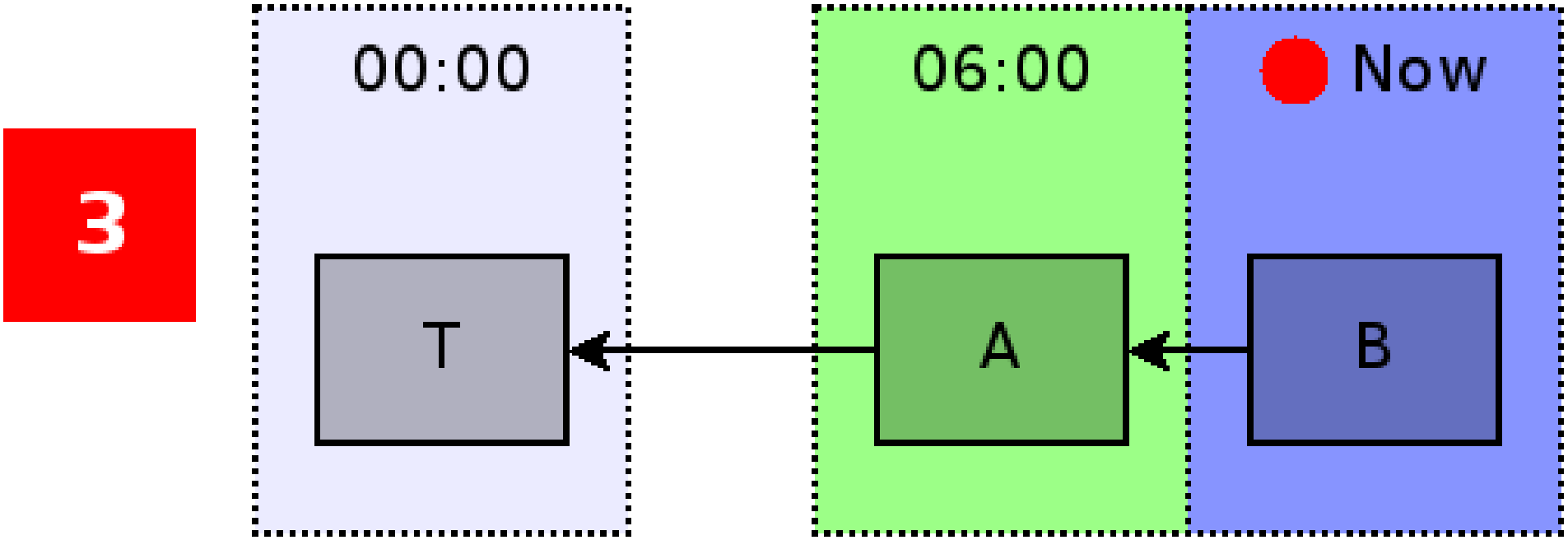


CREATE VOLUME

Creating a live snapshot of a disk



Creating a live snapshot of a disk



FINAL STATE

Deleting a snapshot

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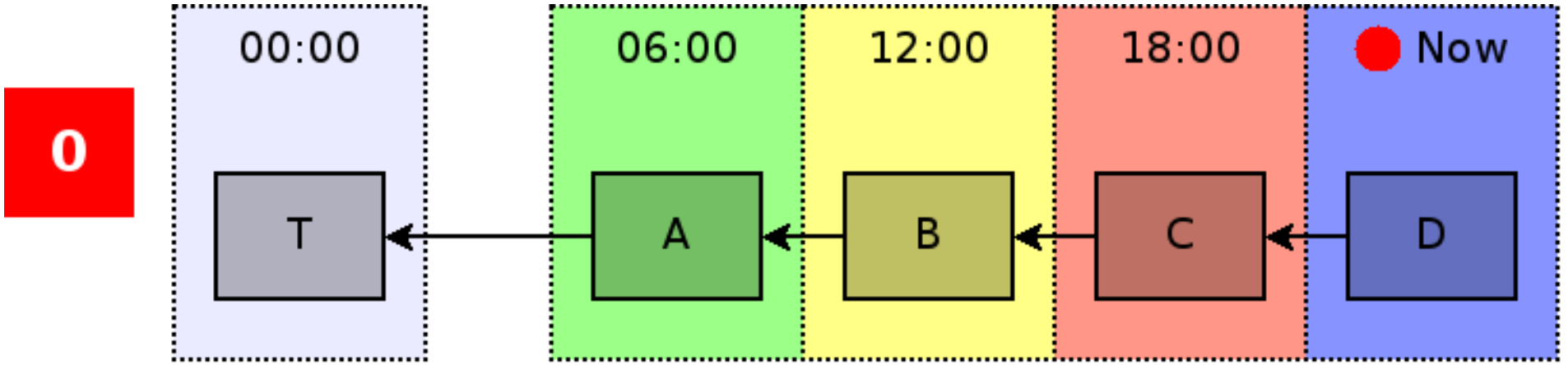
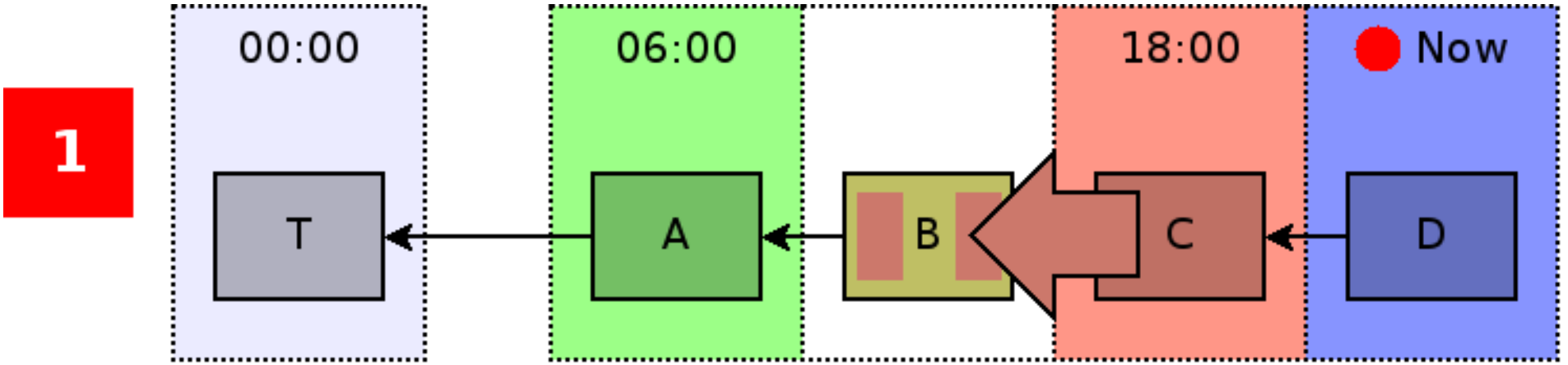
- Why?
  - Increase performance
  - May free up some storage space
  - To support symmetric snapshot operations
- Historically, oVirt has only supported deleting snapshots when a VM is powered off
- Live snapshot deletion is called live merge because two or more adjacent volumes are merged together
- Scenarios
  - Merge direction: forward vs. Backward
  - Merge source: active layer vs. Internal

Backward internal merge



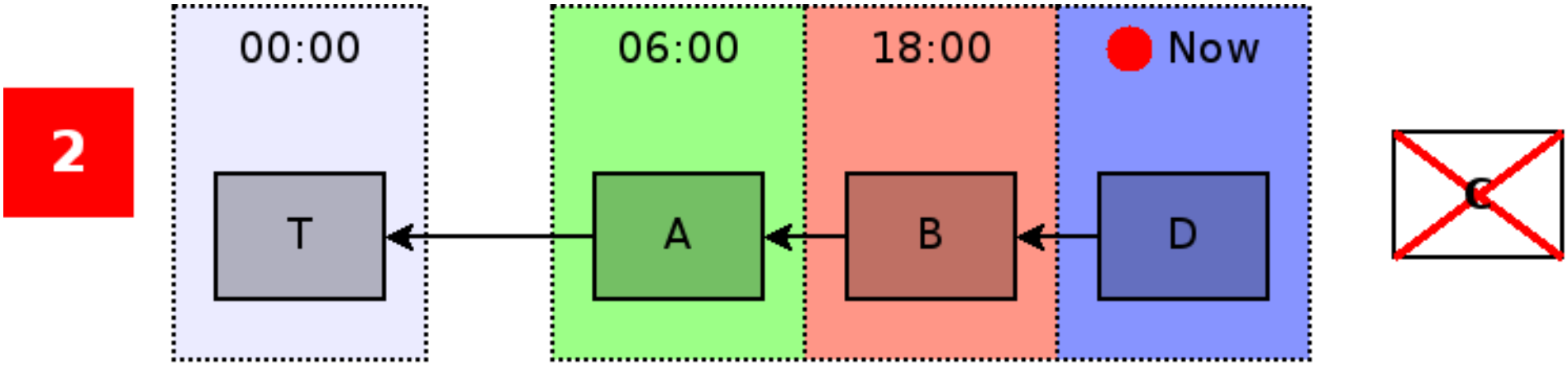
INITIAL STATE

Backward internal merge



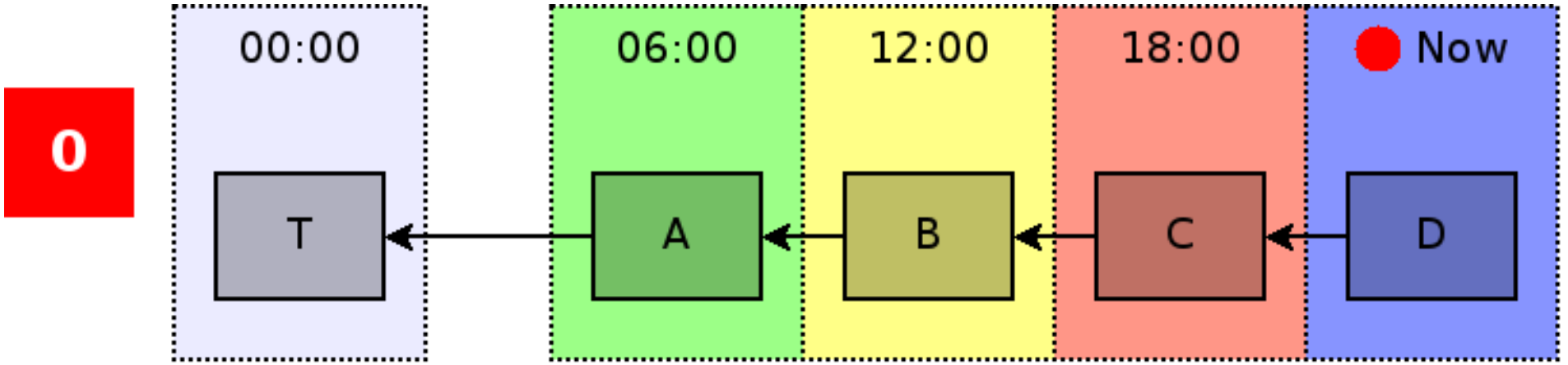
COMMIT ALL BLOCKS

Backward internal merge



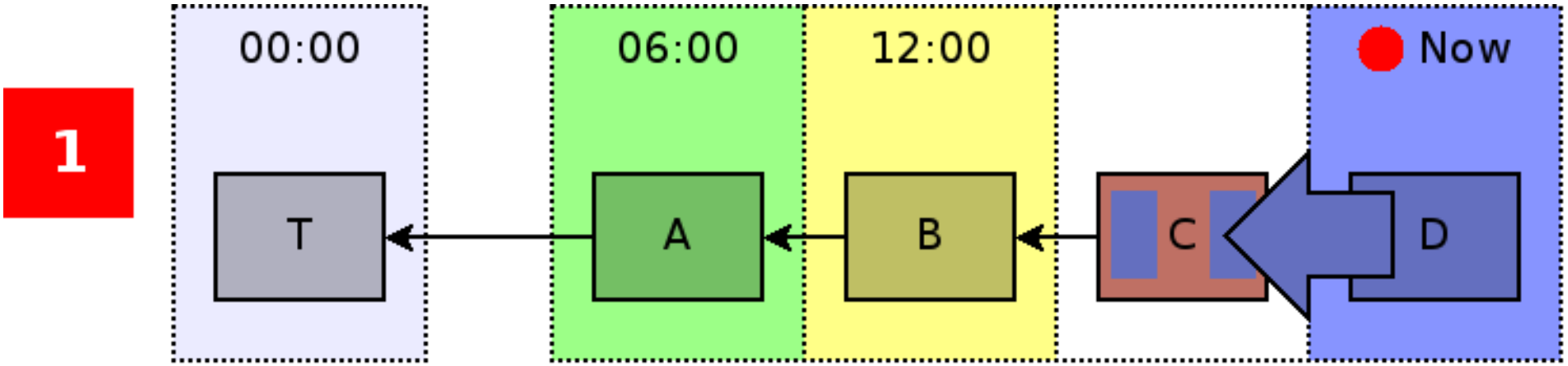
UNLINK AND DELETE MERGED VOLUME

Backward active merge



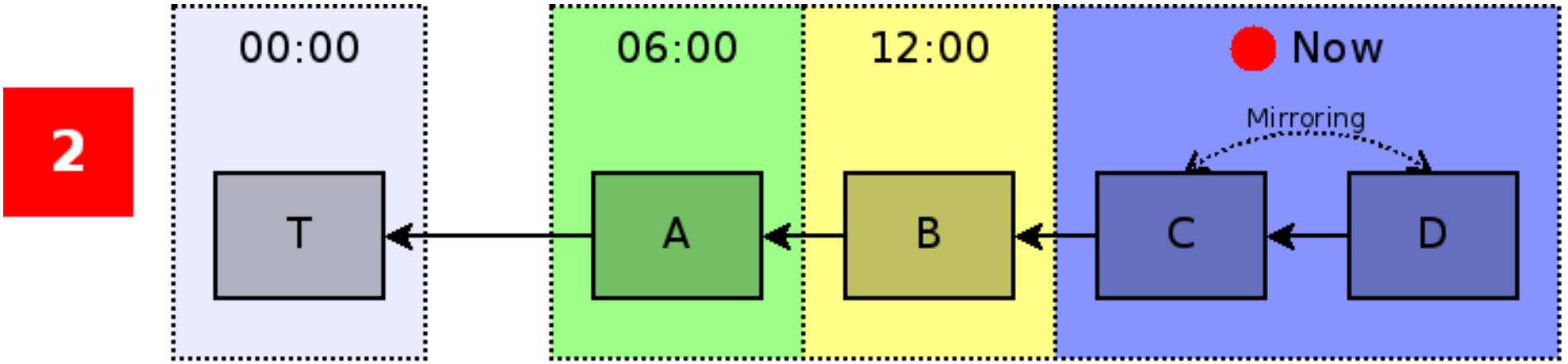
INITIAL STATE

Backward active merge



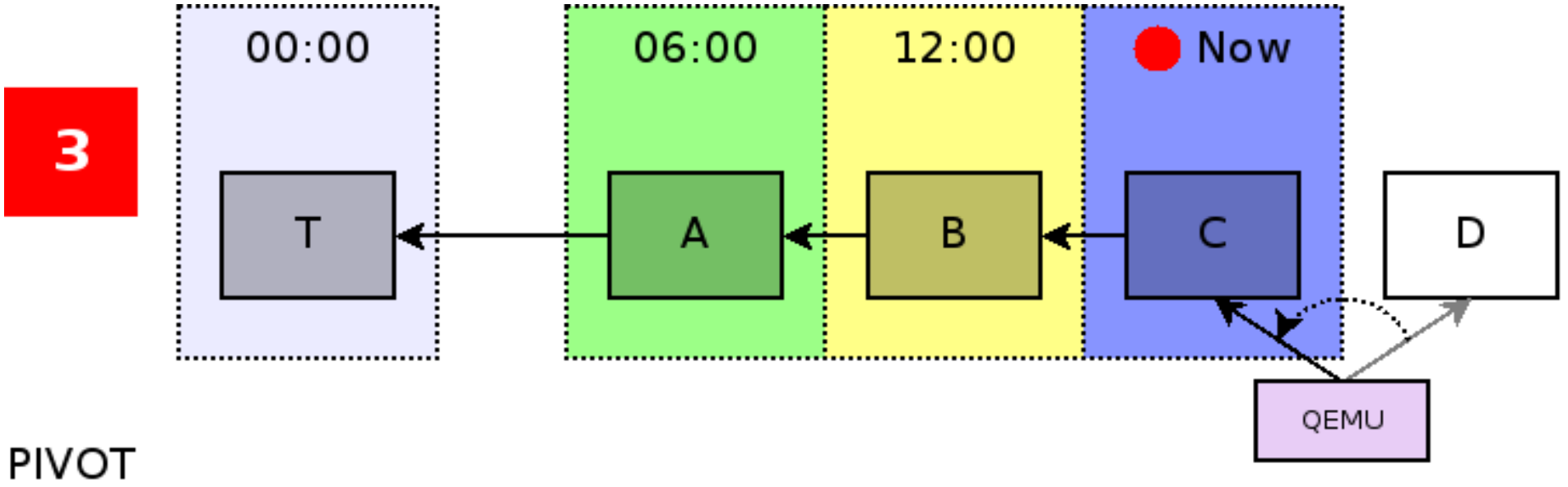
MERGE AND MIRROR WRITES

Backward active merge

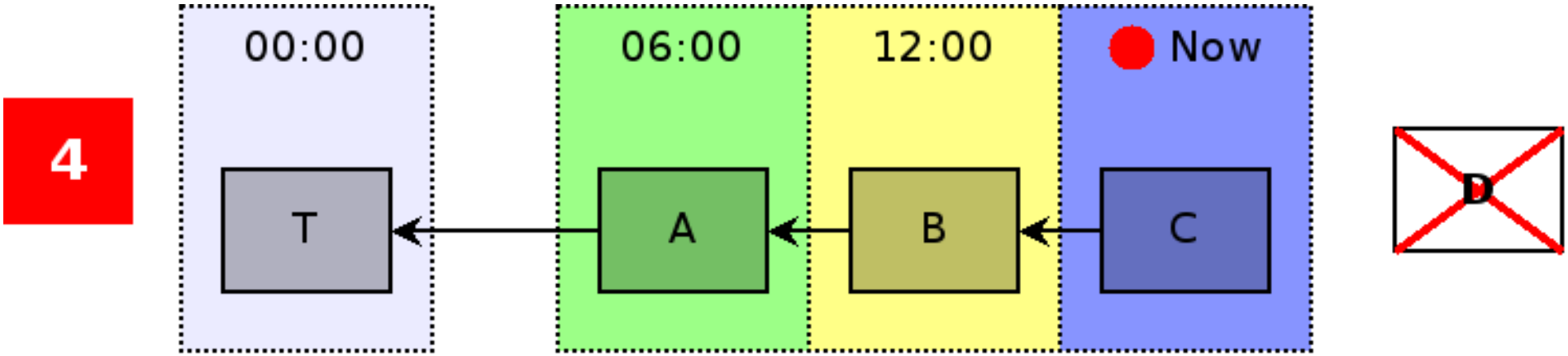


ACTIVE MIRRORING

Backward active merge

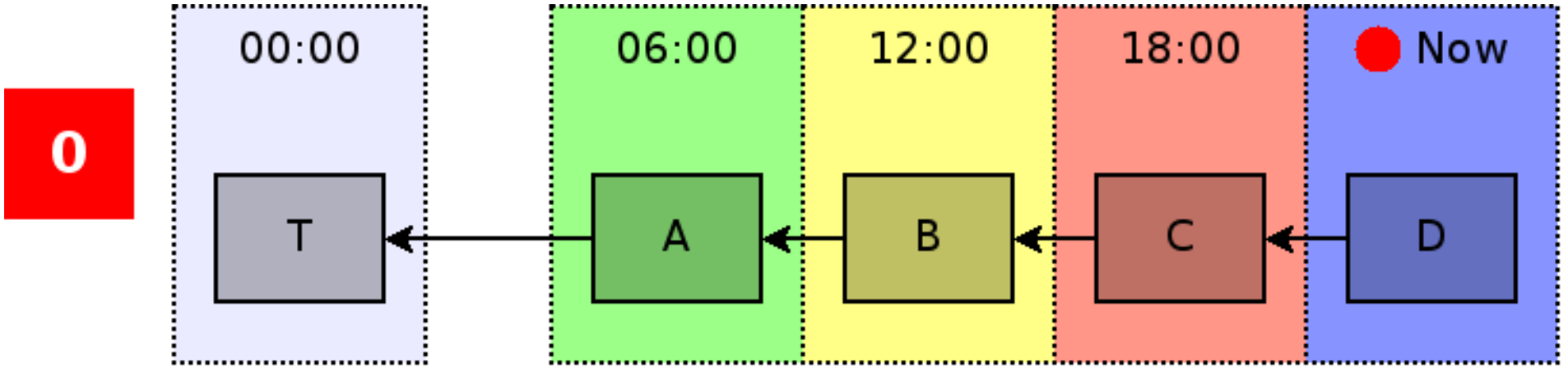


Backward active merge

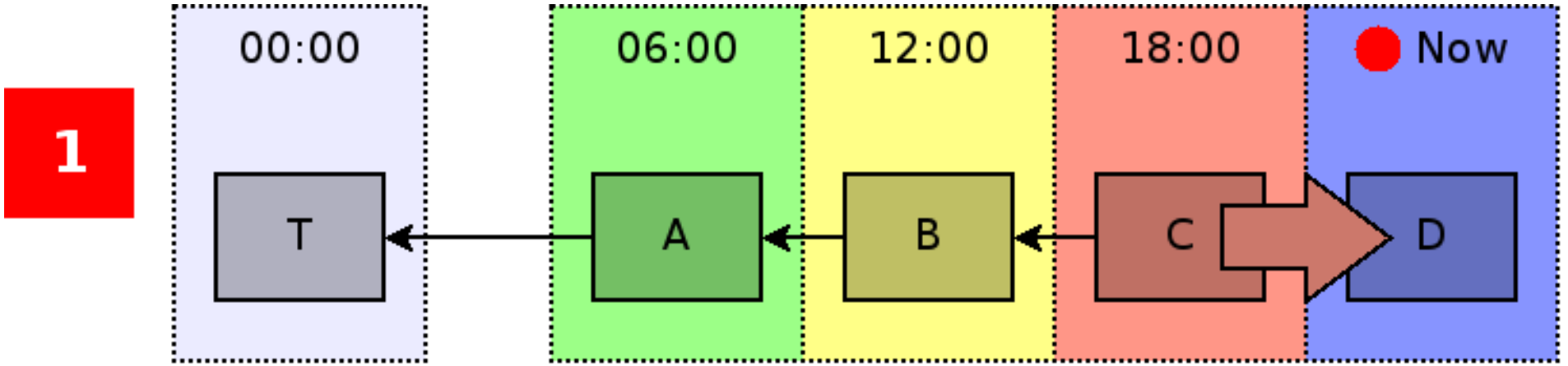


DELETE MERGED VOLUME

Forward active merge

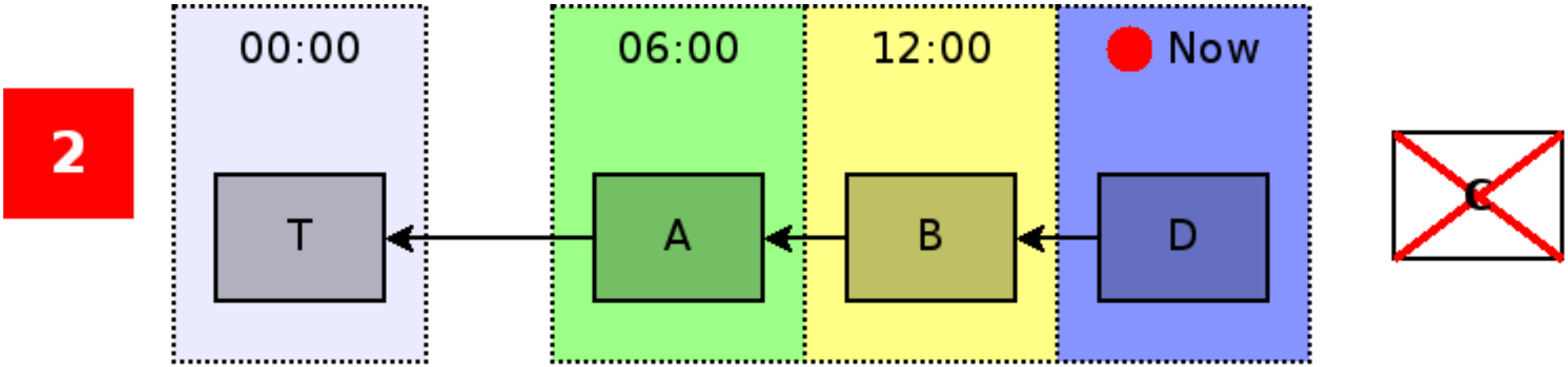


Forward active merge



POPULATE

Forward active merge



UNLINK AND DELETE MERGED VOLUME

Choosing a merge strategy

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- Forward merge
  - libvirt virDomainBlockRebase API
  - Must merge to the active layer
- Backward merge
  - libvirt virDomainBlockCommit API
  - May merge any volume into its parent
- Backward merge is the only feasible choice today but we'd like to have both directions in the future

Libvirt APIs

```
int virDomainBlockCommit(virDomainPtr dom,
                         const char * disk,
                         const char * base,
                         const char * top,
                         unsigned long bandwidth,
                         unsigned int flags)
```

- Starts a live merge operation
- Merges top into base
- You can rate-limit the copy operation if desired
- Flags allow you to set special behavior
  - Request an active layer merge
  - Preserve relative backingStore pointers

Libvirt APIs

```
int virDomainGetBlockJobInfo(virDomainPtr dom,
                             const char * disk,
                             virDomainBlockJobInfoPtr info,
                             unsigned int flags)
```

- Get information about currently running block jobs
  - Job type, bandwidth limit, progress cursor
- When jobs finish an event is emitted and they will no longer be reported by this API

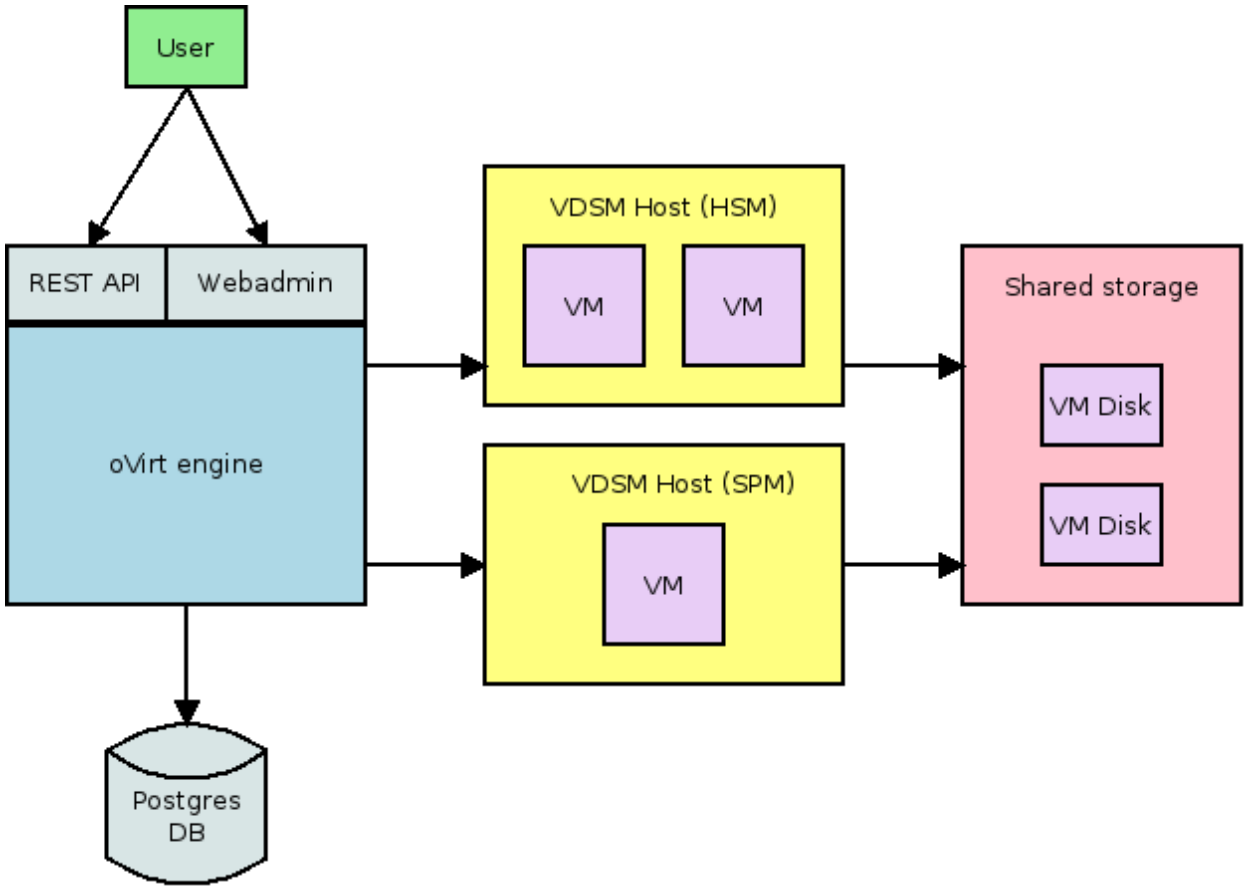
Libvirt APIs

```
int virDomainBlockJobAbort(virDomainPtr dom,
                           const char * disk,
                           unsigned int flags)
```

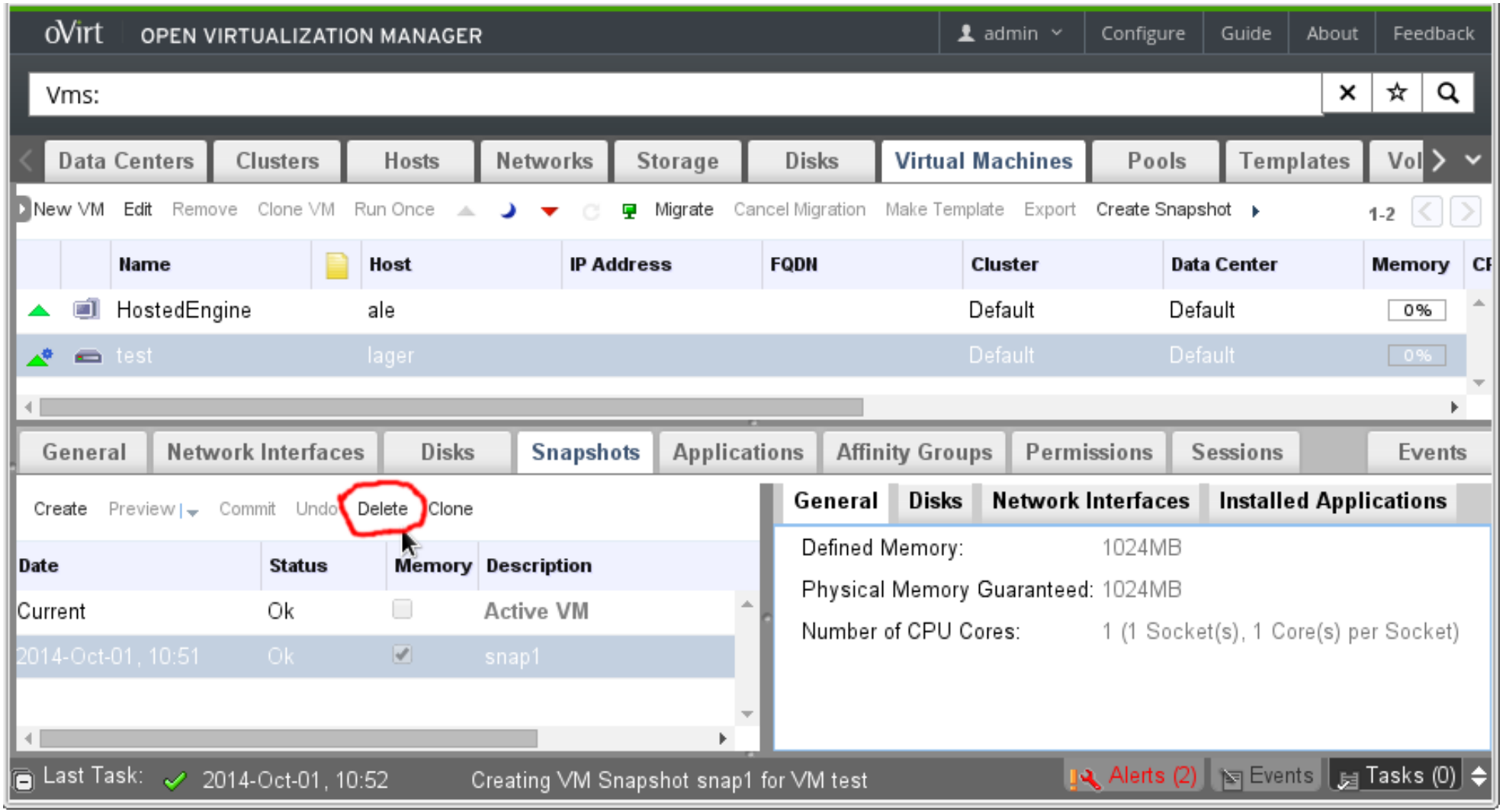
- Cancel the currently running block job on a disk
- Also used to request a pivot after active layer merge

Managing Live Merge for Reliability and Simplicity

oVirt Architecture

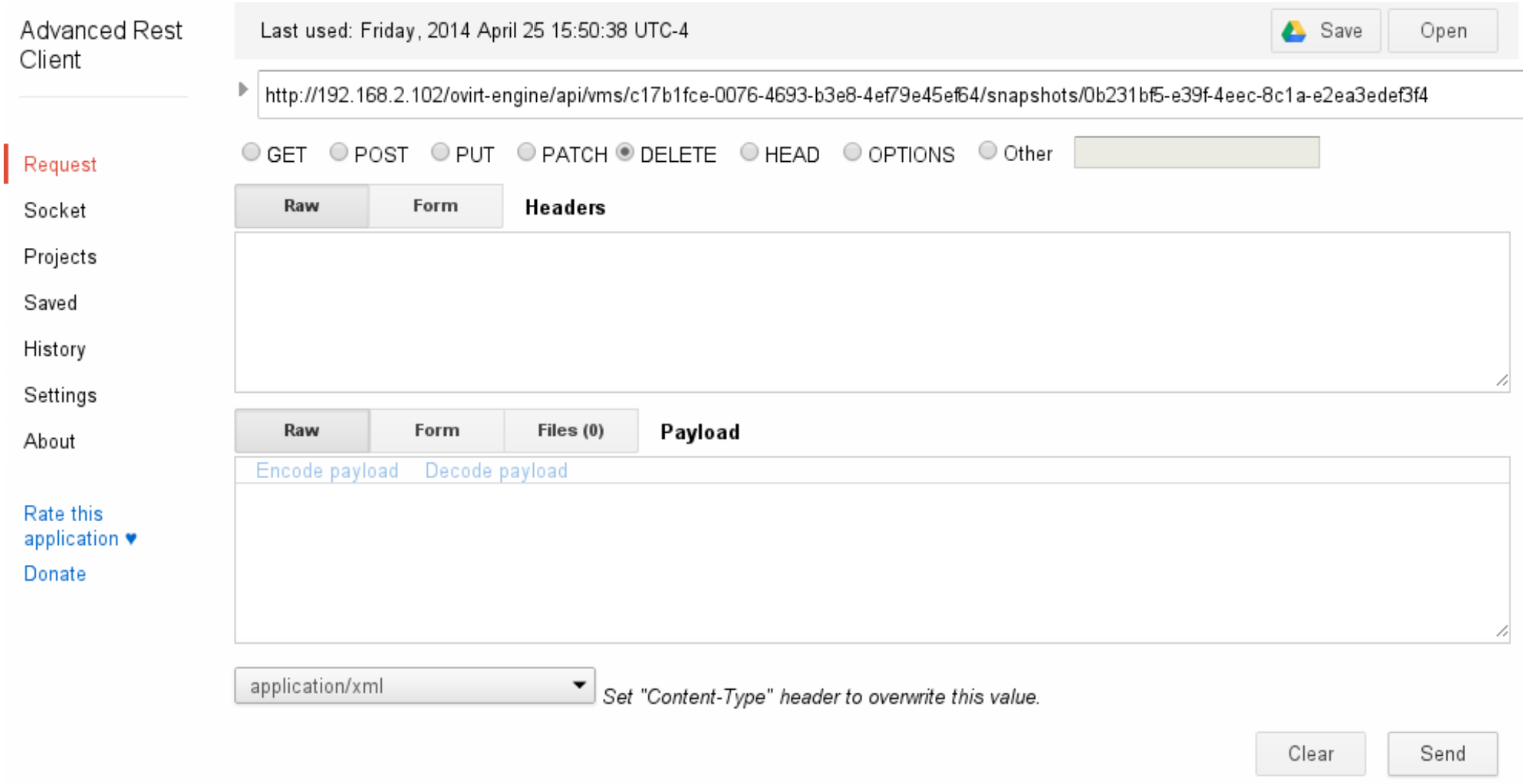


Entry points



Entry points

oVirt

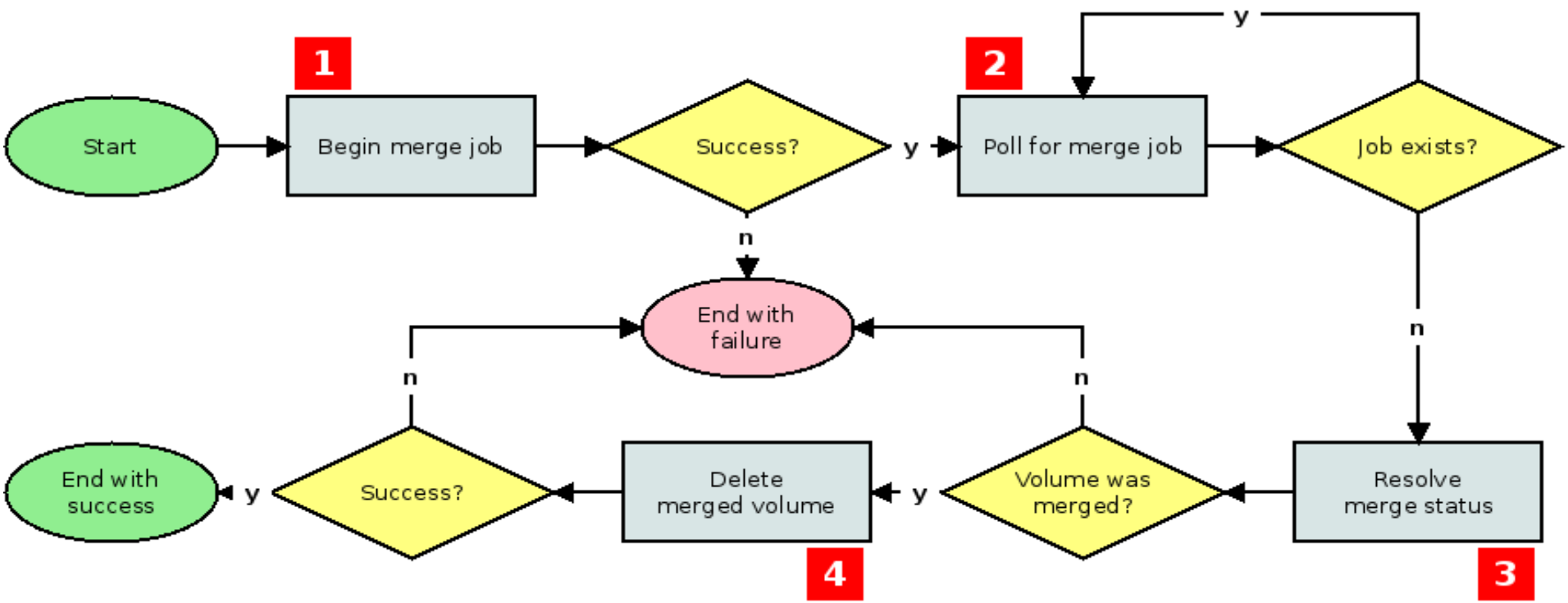


Management value-add

oVirt

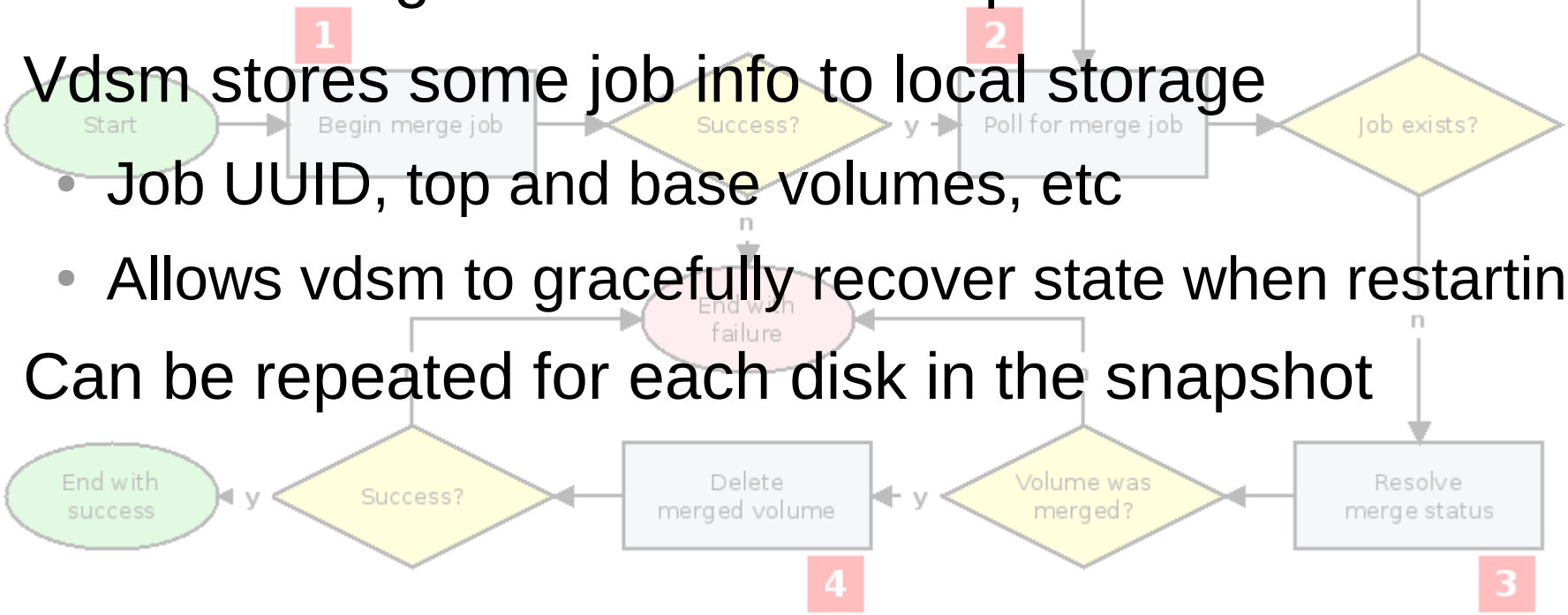
- Hide complexity behind a simple UI and API
- Snapshots involving multiple disks and memory
- Prevent invalid or potentially dangerous operations
  - Revert to a partially merged snapshot
  - Migration during live merge
  - Merge into a shared volume
- Fault tolerance and recovery

High level flow



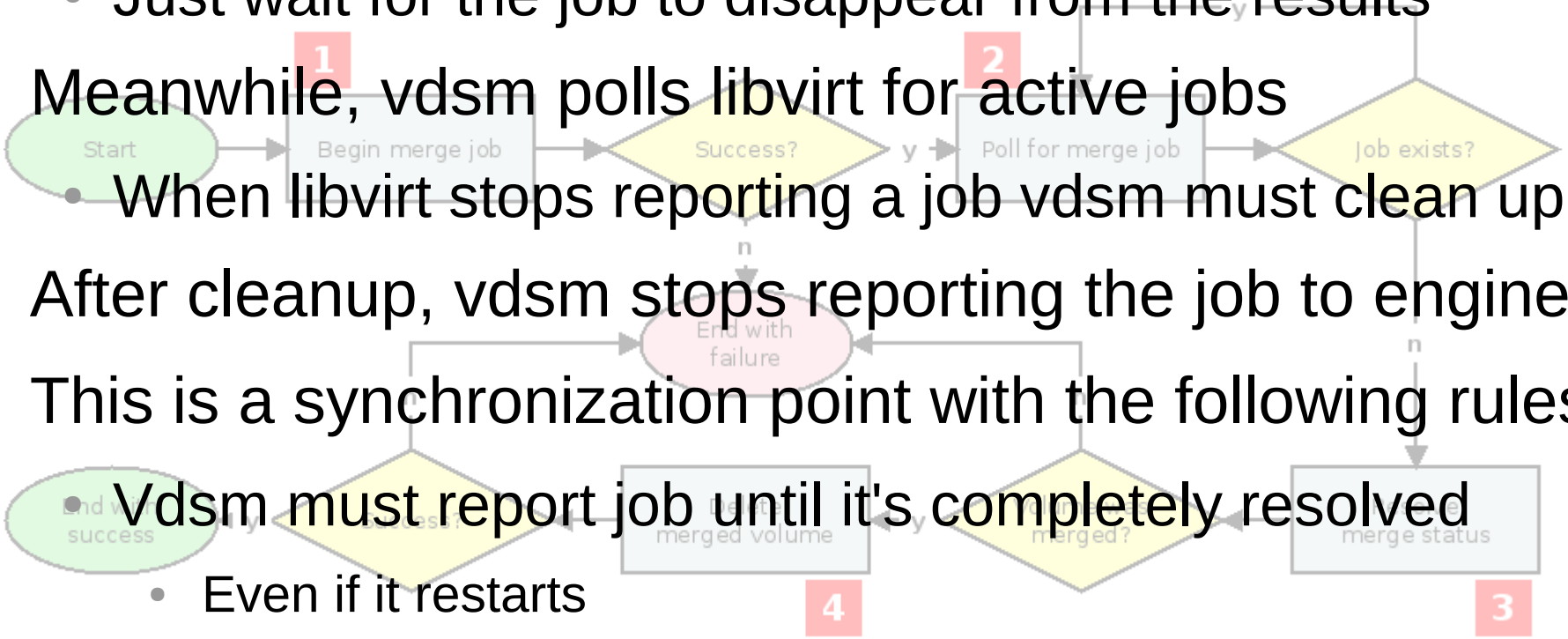
1. Begin merge job

- Ask vdsm to start a live merge for a single vm disk
- Assume merge started unless explicit error is returned
- Vdsm stores some job info to local storage
  - Job UUID, top and base volumes, etc
  - Allows vdsm to gracefully recover state when restarting
- Can be repeated for each disk in the snapshot



2. Wait for merge job

- Engine periodically polls vdsm to get active jobs
  - Just wait for the job to disappear from the results
- Meanwhile, vdsm polls libvirt for active jobs
  - When libvirt stops reporting a job vdsm must clean up
- After cleanup, vdsm stops reporting the job to engine
- This is a synchronization point with the following rules
  - Vdsm must report job until it's completely resolved
    - Even if it restarts
  - If engine does not receive any job info it must try again
  - When the job stops being reported advance to next step



2. Wait for merge job (cleanup)

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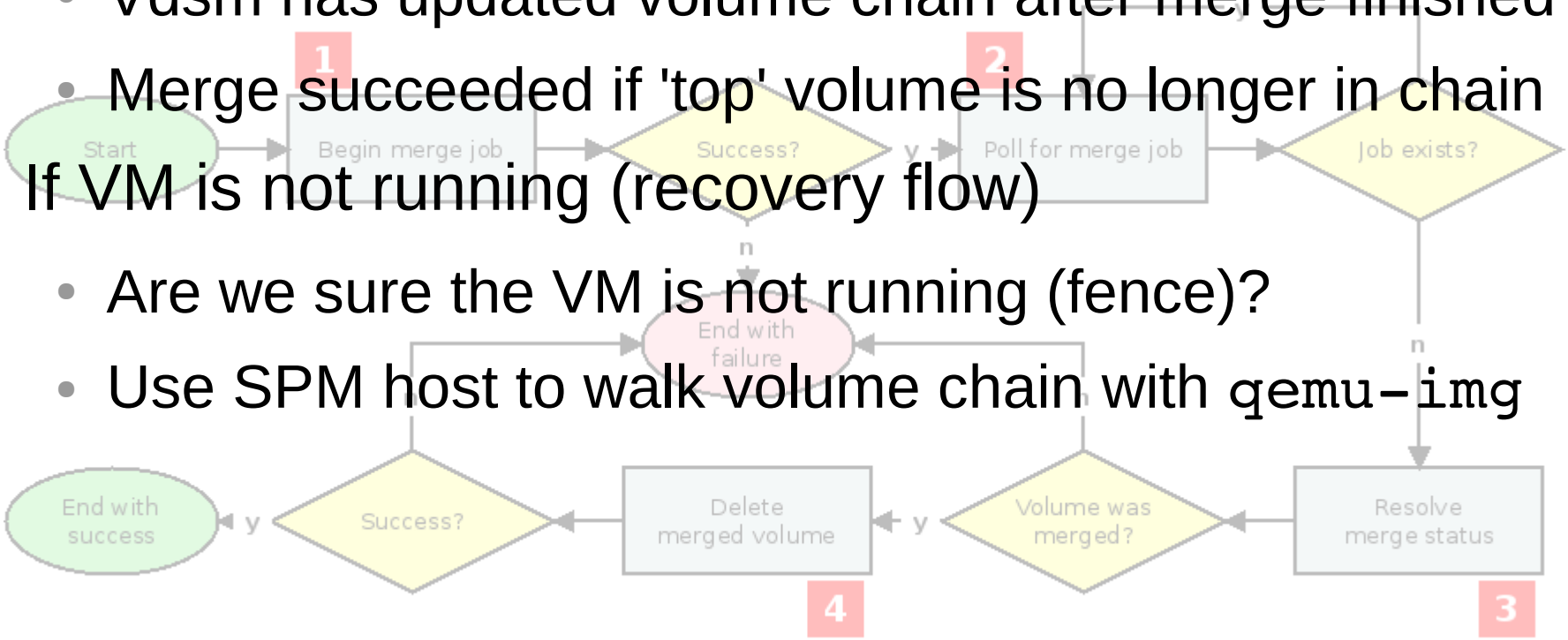
- Step 1: Manual pivot (active layer merge only)
  - Indicator: libvirt job info cursor is at 100%
  - Vdsm asks libvirt to pivot to the new active volume
- Step 2: Volume chain synchronization (all merges)
  - Indicator: libvirt job no longer reported
  - Vdsm gets new volume chain from libvirt XML
  - Vdsm syncs volume chain metadata on storage
  - Vdsm syncs in-memory volume chain info for VM
- Step 3: Stop reporting live merge job to engine

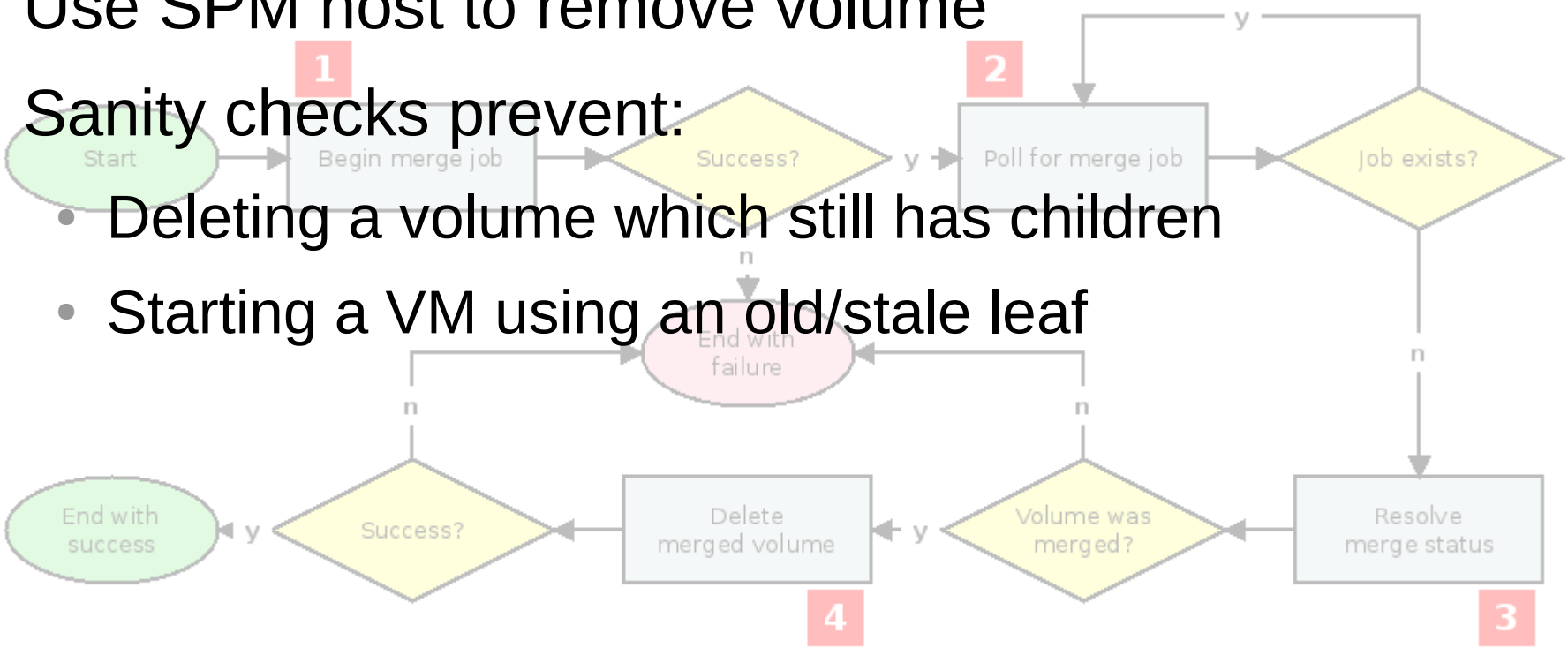
3. Resolve merge status

- Engine requests live VM configuration from vdsm
  - Vdsm has updated volume chain after merge finished
  - Merge succeeded if 'top' volume is no longer in chain
- If VM is not running (recovery flow)
  - Are we sure the VM is not running (fence)?
  - Use SPM host to walk volume chain with `qemu-img`



4. Delete merged volume

- Merge was successful and 'top' should be deleted
- Use SPM host to remove volume
- Sanity checks prevent:
  - Deleting a volume which still has children
  - Starting a VM using an old/stale leaf



Polling vs. event handling

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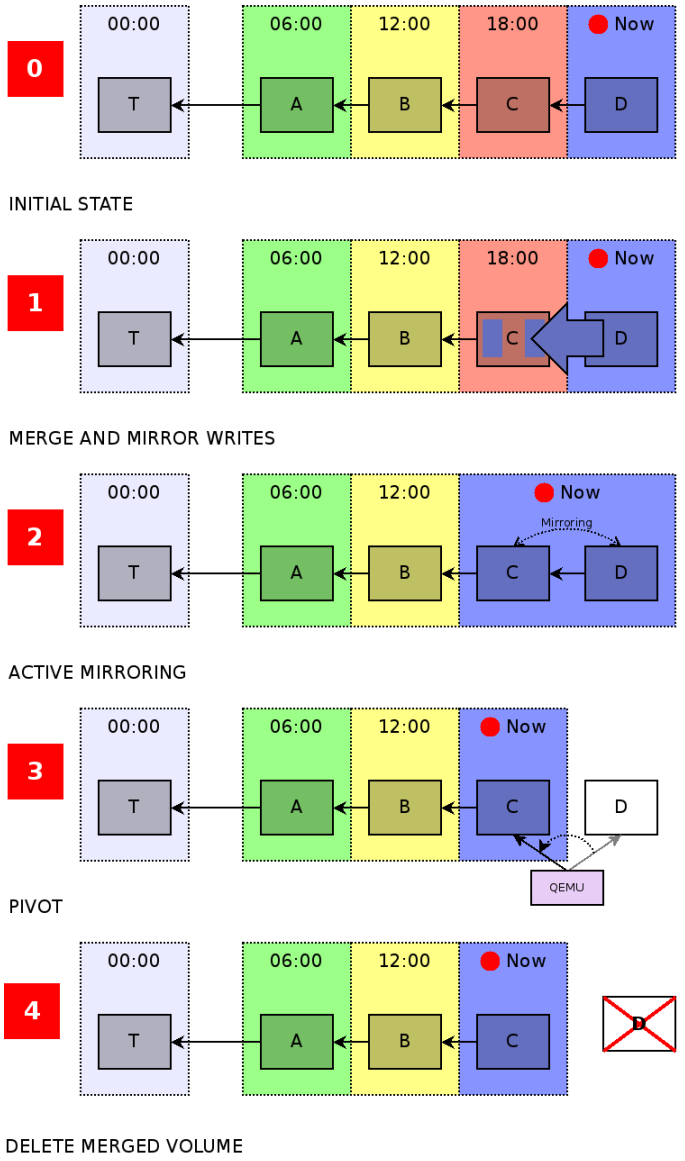
- Events would be passed from
  qemu -> libvirt -> vdsm -> ovirt-engine
- If any component goes down we might miss an event
- To ensure recoverability, it must be possible to query the current state by asking two questions of the system
  - Is the job active?
  - If not, did it succeed or fail?
- Event handling could be added in the future as an optimization to eliminate polling delays for the common case.

Scenario: qemu crash

- Is merge running? No.
- Use SPM host to run a recovery command
  - Run `qemu-img` to get current volume chain
  - Discard mirrored leaf if present
  - Correct vdsm metadata and return new chain
- Mirrored leafs are flagged in vdsm metadata before a pivot is requested



Scenario: manager and vdsm restart

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- VDSM restart
  - Manager has a lapse in merge job info during restart and will continue to poll until reporting resumes
  - Upon restart vdsm recovers the list of tracked jobs and handling will resume the next time libvirt is polled
- Manager restart
  - Live merge is a sequence of individual commands
  - Current progress is saved to the DB and the command state will be restored upon restart

Scenario: manager / virt host destroyed

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- Manager
  - In this case the DB is lost and it will be necessary to rebuild the oVirt environment
  - Data domain import allows you to recover VMs and templates from previous install
  - We must check all Vms on import as if qemu crashed
- Virtualization host
  - Admin must confirm that the host has been rebooted
  - Use qemu crash logic to synchronize and then the VM can be restarted on a different host

Future Work

Future work

oVirt

- Automatic removal of temporary snapshots after live storage migration and VM backup
- Data domain import hook to sync vm volume chains
- Use forward merge if it would reduce I/O
- Improve responsiveness by using libvirt events and emitting vdsm events
- Delete multiple adjacent snapshots in one operation
- Rolling snapshots

THANK YOU !

http://www.ovirt.org/Features/Live_Merge
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