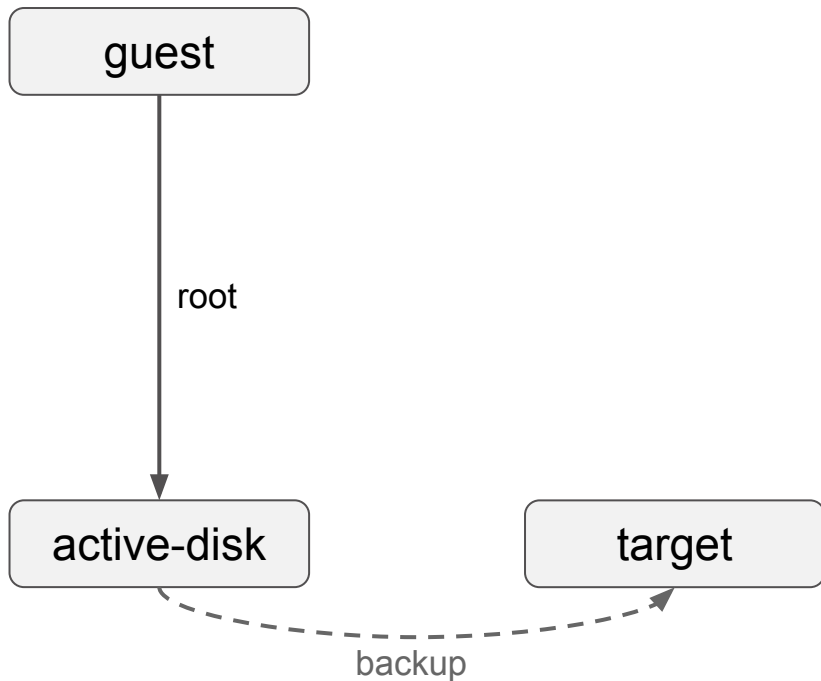# New Qemu Backup Architecture and API

**Vladimir Sementsov-Ogievskiy**
**September 2021**

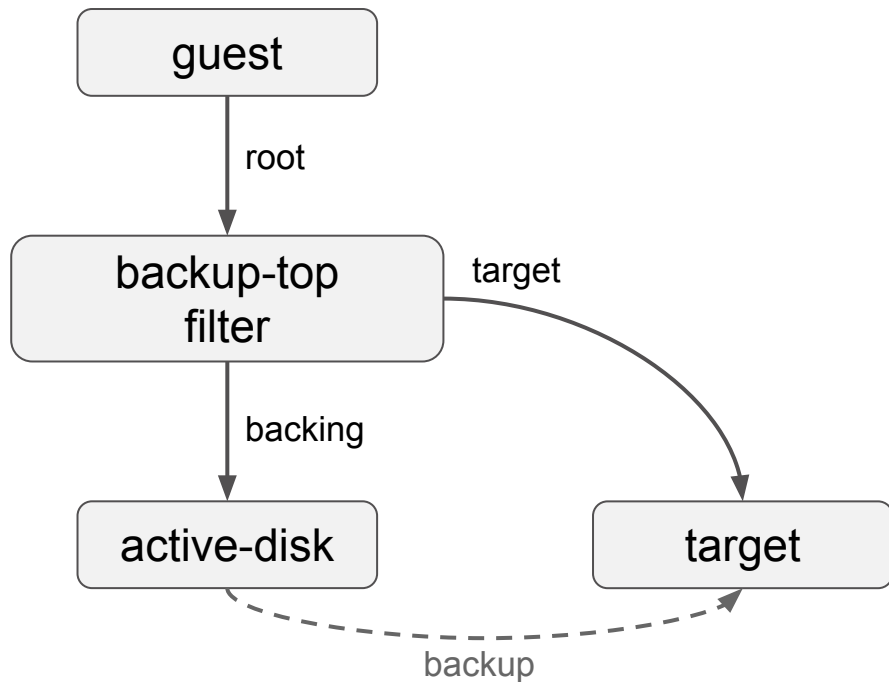# QEMU Backup



```
QMP API:
1. blockdev-add {
       node-name: "target",

       ...
   }
2. blockdev-backup {
       drive: "active-disk",
       target: "target",
       sync: "full"
   }
```
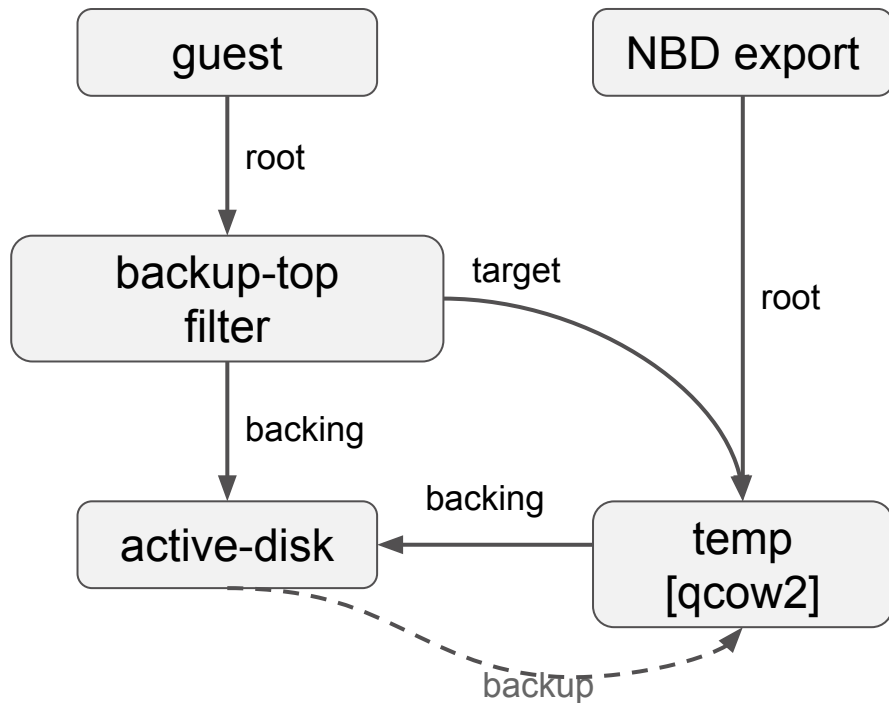
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# QEMU Backup

```
guest
  |
  | root
  v
backup-top
filter  ----target----+
  |                    |
  | backing           |
  v                    v
active-disk          target
  ·                    ^
  ·····backup··········+
```

QMP API:
1. blockdev-add {
       node-name: "target",

       ...
   }
2. blockdev-backup {
       device: "active-disk",
       target: "target",
       sync: "full"
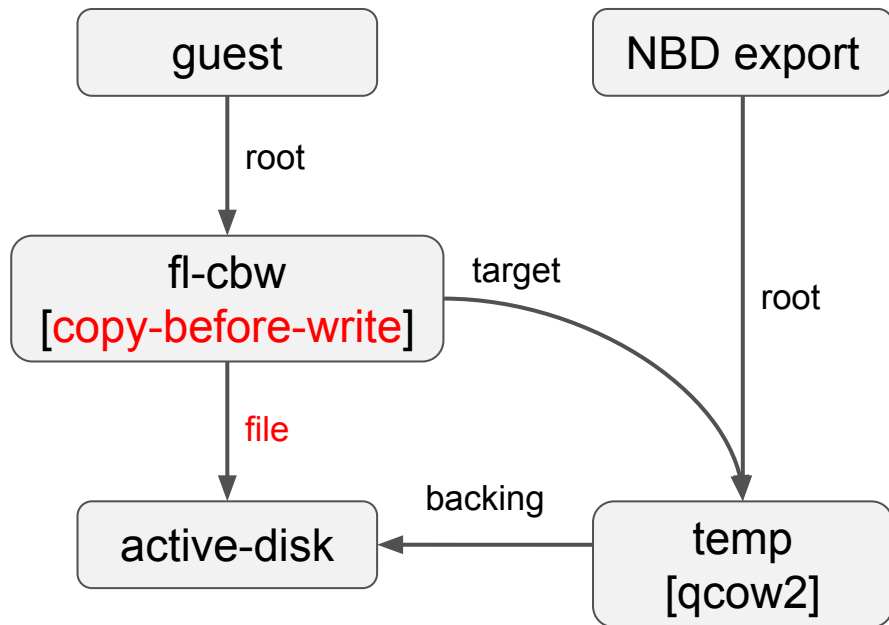   }

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# Image fleecing



```
QMP API:
1. blockdev-add {
      node-name: "temp",
      driver: "qcow2",
      backing: "active-disk",
      ...
   }
2. blockdev-backup {
      device: "active-disk",
      target: "target",
      sync: "none"
   }
```

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# QEMU Backup



**series:** [PATCH v8 00/34] block: publish backup-top filter

# QEMU Backup



```
QMP API:
1. blockdev-add {
       node-name: "temp",
       driver: "qcow2",
       backing: "active-disk"
   }
```

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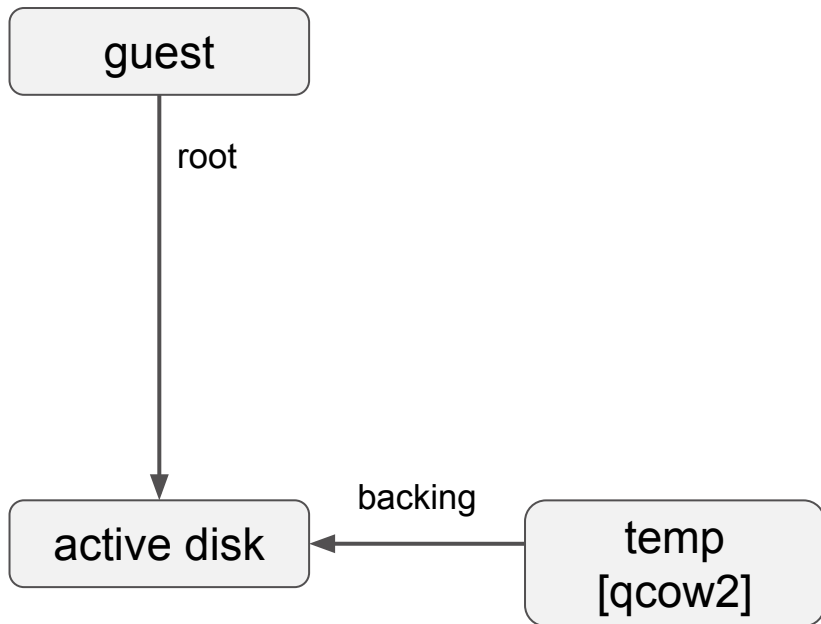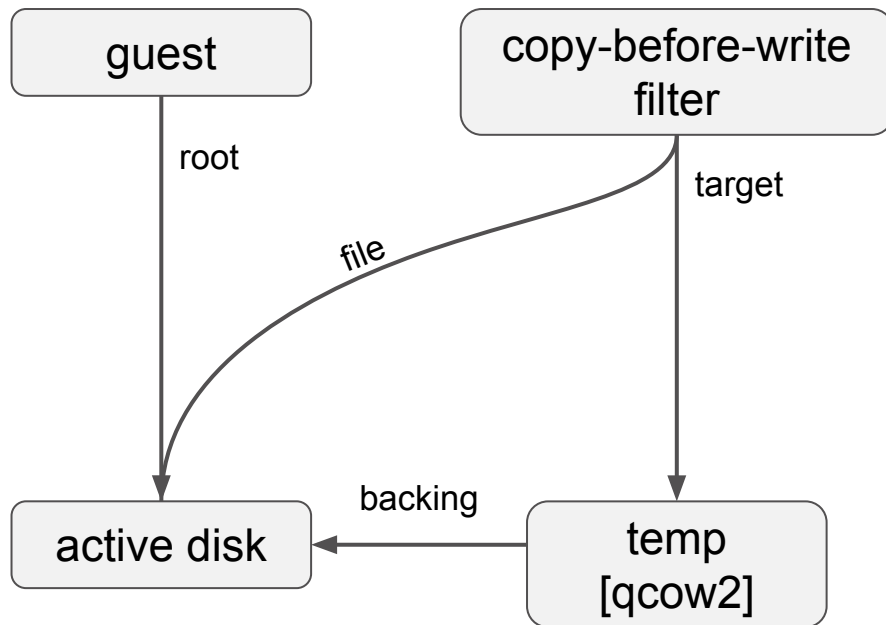
# QEMU Backup



```
QMP API:
1. blockdev-add {
    node-name: "target",
    driver: "qcow2",
    backing: "active-disk"
   }
2. blockdev-add {
    node-name: "fl-cbw",
    driver: "copy-before-write",
    file: "active-disk",
    target: "target",
    [bitmap: {...}]
   }
```

**series:** [PATCH v8 00/34] block: publish backup-top filter

# QEMU Backup

```
guest
  |
  | root
  v
fl-cbw
[copy-before-write]  --target-->  temp
  |                                [qcow2]
  | file                             |
  v                                  | backing
active-disk  <------backing---------/
```

QMP API:
1. blockdev-add {
       node-name: "target",
       driver: "qcow2",
       backing: "active-disk"
   }
2. blockdev-add {
       node-name: "fl-cbw",
       driver: "copy-before-write",
       file: "active-disk",
       target: "target",
       [bitmap: {...}]
   }
3. qom-set {
       path: "/machine/peripheral/sda",
       property: "drive",
       value: "fl-cbw"
   }

**series:** [PATCH v8 00/34] block: publish backup-top filter

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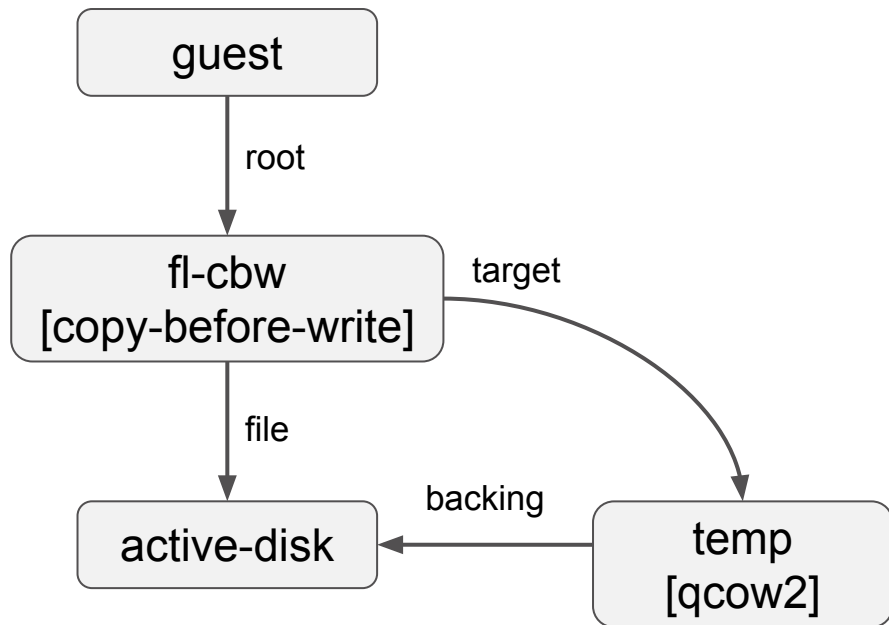
# QEMU Backup



```
QMP API:
1. blockdev-add {
       node-name: "target",
       driver: "qcow2",
       backing: "active-disk"
   }
2. blockdev-add {
       node-name: "fl-cbw",
       driver: "copy-before-write",
       file: "active-disk",
       target: "target",
       [bitmap: {...}]
   }
3. qom-set {
       path: "/machine/peripheral/sda",
       property: "drive",
       value: "fl-cbw"
   }
```
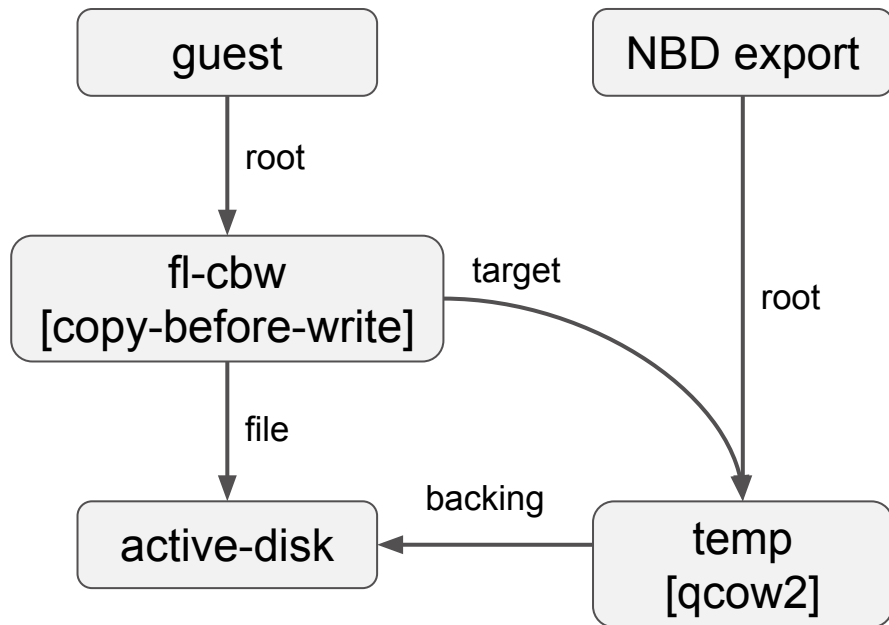
Diagram nodes: guest —root→ fl-cbw [copy-before-write] —file→ active-disk; fl-cbw —target→ temp [qcow2] —backing→ active-disk; NBD export —root→ temp [qcow2]

**series:** [PATCH v8 00/34] block: publish backup-top filter

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# QEMU Backup

**series:** [PATCH v8 00/34] block: publish backup-top filter

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# QEMU Backup

**Shortcomings:**
1. extra c-b-w operations
2. extra writes to temp



**series:** [PATCH v8 00/34] block: publish backup-top filter

# QEMU Backup

**Shortcomings:**
1. extra c-b-w operations
2. extra writes to temp

```
                                    ┌──────────────┐
  ┌──────────────┐                  │  NBD export  │
  │    guest     │                  └──────────────┘
  └──────────────┘                         │
         │ root                            │ root
         ▼                                 ▼
  ┌──────────────┐     target        ┌──────────────┐
  │    fl-cbw    │──────────────────▶│     temp     │
  │[copy-before- │                   │   [qcow2]    │
  │   write]     │                   └──────────────┘
  └──────────────┘                         │
         │ file          backing           │
         ▼          ◀────────────────      │
  ┌──────────────┐                         
  │ active-disk  │◀────────────────────────
  └──────────────┘
```
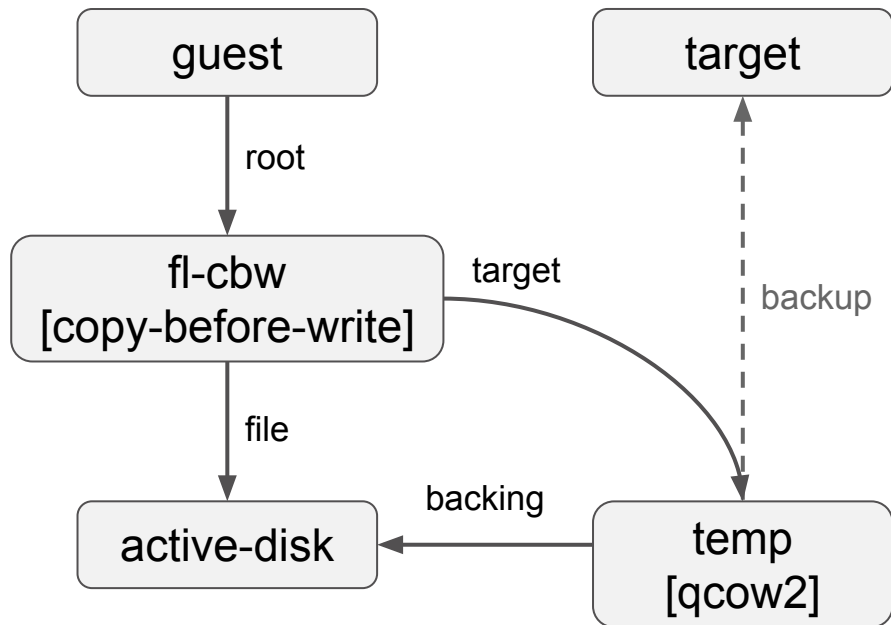
**series:** [PATCH v8 00/34] block: publish backup-top filter

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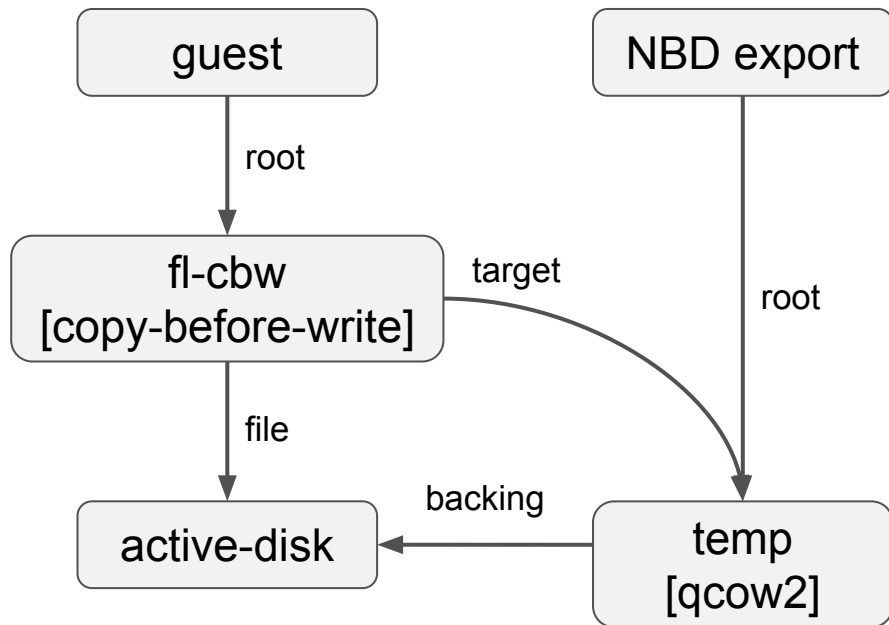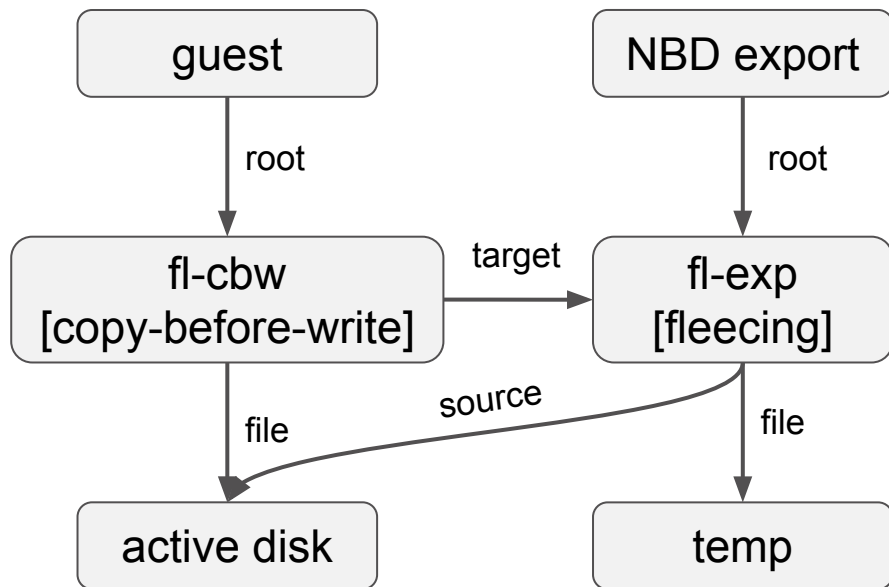
# QEMU Backup



**Benefits:**
1. `discard: no extra c-b-w`
2. `restrict access to bitmap`
3. `more effective synchronization`
4. `don't rely on backing`
5. `c-b-w caching`

Diagram:
- guest → (root) → fl-cbw [copy-before-write]
- NBD export → (root) → fl-exp [fleecing]
- fl-cbw [copy-before-write] → (target) → fl-exp [fleecing]
- fl-cbw [copy-before-write] → (file) → active disk
- fl-exp [fleecing] → (source) → active disk
- fl-exp [fleecing] → (file) → temp

**series:** [PATCH v2 00/19] Make image fleecing more usable

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# QEMU Backup

```
guest          NBD export
  │               │
  │ root          │ root
  ▼               ▼
fl-cbw   target  fl-exp
[copy-before-write] ──▶ [fleecing]
  │          source      │
  │ file     ◀──────     │ file
  ▼                      ▼
active disk            temp
```
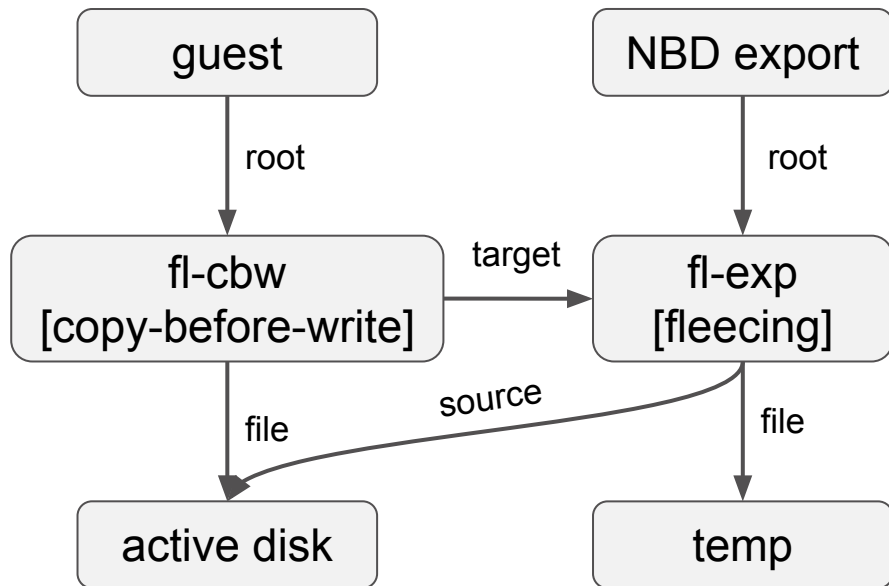
```
QMP API:
1. blockdev-add { target }
2. blockdev-add {
     node-name: "fl-exp",
     driver: "fleecing",
     file: "temp",
     source: "active-disk"
   }
3. blockdev-add {
     node-name: "fl-cbw",
     driver: "copy-before-write",
     file: "active-disk",
     target: "fl-exp"
   }
4. qom-set { fl-cbw }
```
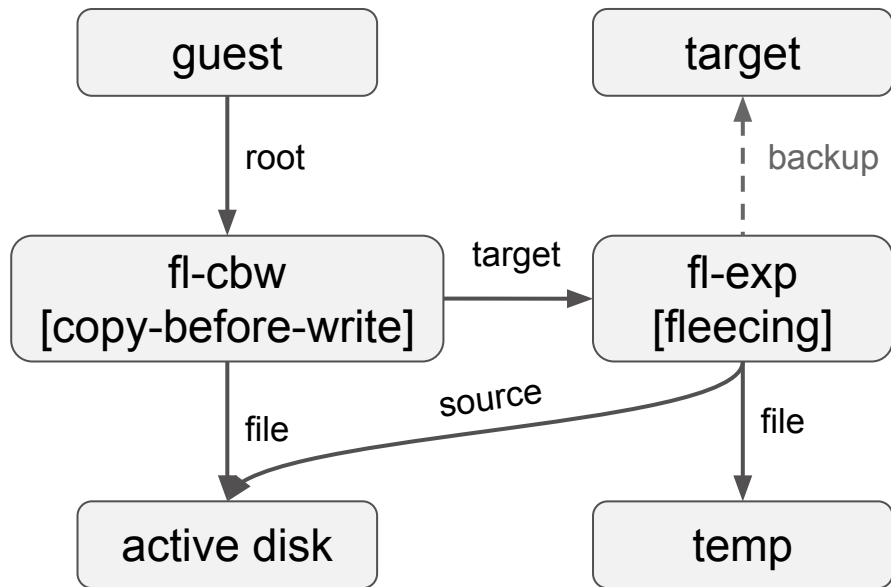
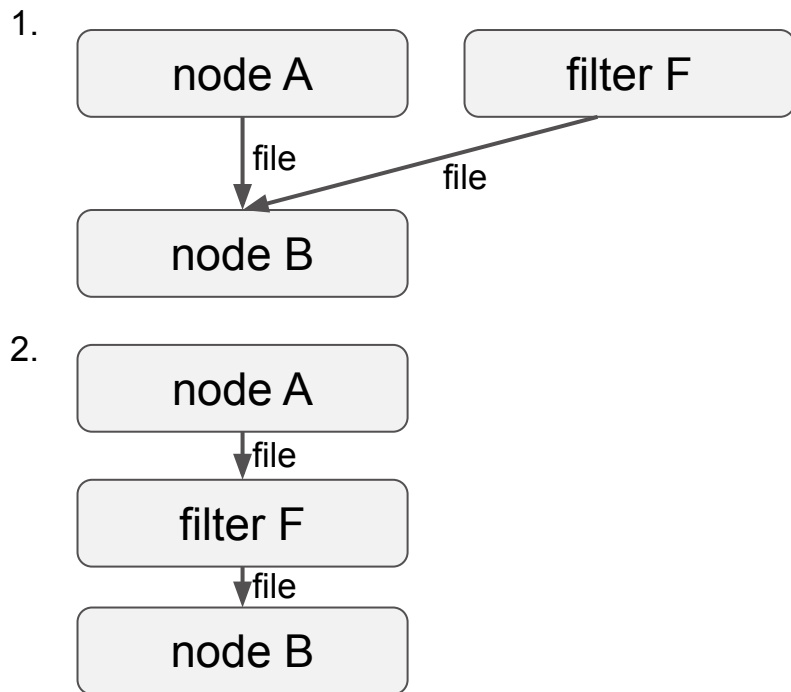**series:** [PATCH v2 00/19] Make image fleecing more usable

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# QEMU Backup

**QMP API:**
1. `setup fleecing`
2. `blockdev-add { target }`
3. `blockdev-backup {`
   `device: "temp",`
   `target: "target",`
   **`immutable-source: true,`**
   `...`
   `}`

```
        guest                    target
          |                        ^
          | root             backup :
          v                        :
    fl-cbw          target    fl-exp
    [copy-before-write] ----> [fleecing]
          |          source  /      |
          | file            /       | file
          v        <-------'        v
     active disk              temp
```

**series:** [PATCH v2 00/19] Make image fleecing more usable

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# Inserting filters

1.

```
┌─────────────────┐   ┌─────────────────┐
│     node A      │   │     filter F    │
└─────────────────┘   └─────────────────┘
        │ file              │ file
        ▼                   ▼
┌─────────────────┐
│     node B      │
└─────────────────┘
```

2.

```
┌─────────────────┐
│     node A      │
└─────────────────┘
        │ file
        ▼
┌─────────────────┐
│     filter F    │
└─────────────────┘
        │ file
        ▼
┌─────────────────┐
│     node B      │
└─────────────────┘
```

```
QMP API:
1. blockdev-add {
       node-name: "F",
       driver: "some-filter-drv",
       file: "B",
       ...
   }
2. blockdev-reopen {
       node-name: "A",
       file: "F",
       [all other non-default opts],
       ...
   }
```
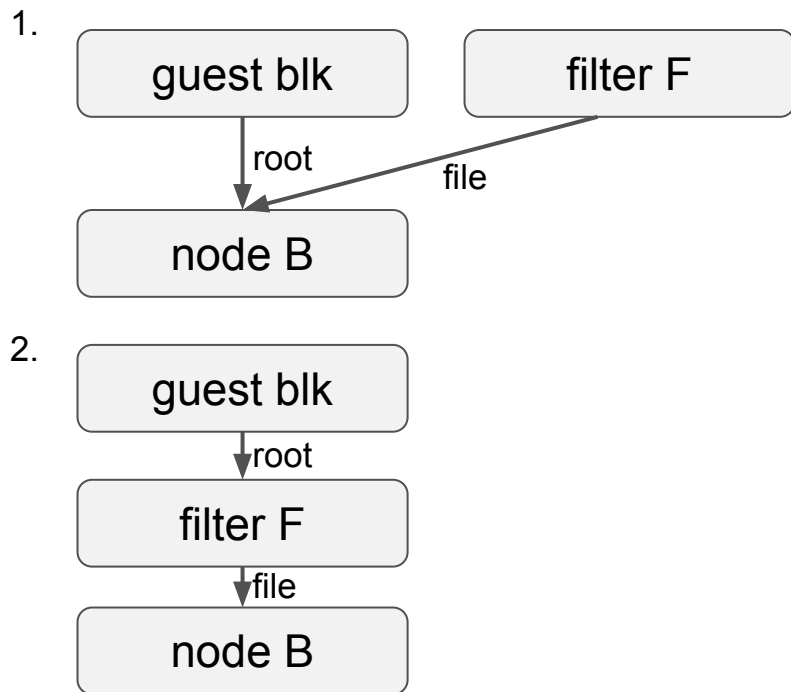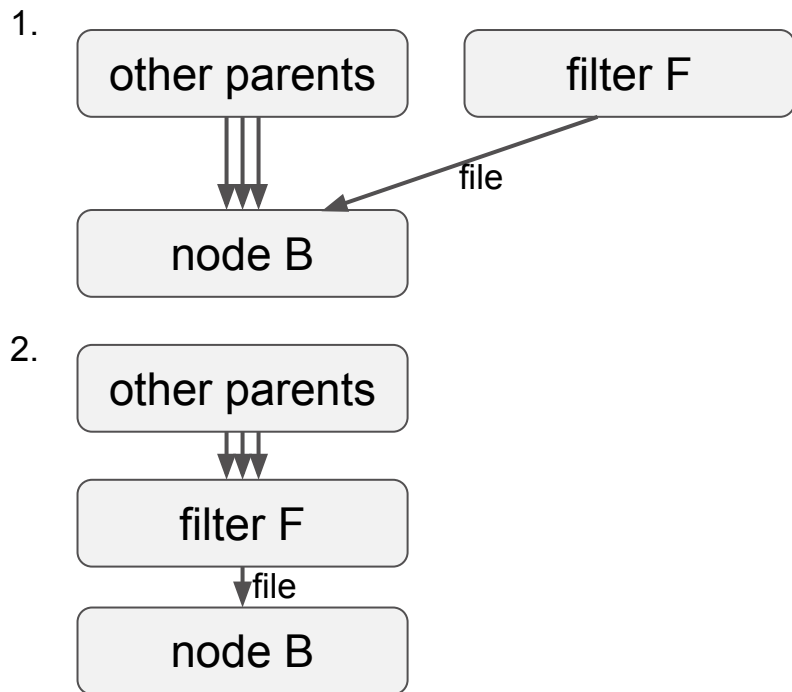
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# Inserting filters

1.

```
guest blk              filter F
    |                      /
    | root           file/
    v              <-
 node B
```

2.

```
guest blk
    |
    | root
    v
 filter F
    |
    | file
    v
 node B
```

**QMP API:**
```
1. blockdev-add {
     node-name: "F",
     driver: "some-filter-drv",
     file: "B",
     ...
   }
2. qom-set {
     path: "/machine/peripheral/sda",
     property: "drive",
     value: "F"
   }
```

**series:** [PATCH v8 00/34] block: publish backup-top filter

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# Inserting filters

1.

other parents     filter F

node B

file

2.

other parents

filter F

file

node B

**series:** [PATCH RFC 0/8] blockdev-replace

```
QMP API:
1. blockdev-add {
      node-name: "F",
      driver: "some-filter-drv",
      file: "B",
      ...
   }
2. blockdev-replace {
      parent-mode: "auto",
      child: "B",
      new-child: "F"
   }
```

# Finally, what's new:

- Internal "backup-top" filter driver becomes public "copy-before-write" filter driver with "bitmap" option
- New "fleecing" block driver
- New fleecing scheme is based on these new drivers and doesn't use backup job and backing feature
- "immutable-source" option for backup
- New "blockdev-replace" command for filter insertion

## Where:

- [PATCH v8 00/34] block: publish backup-top filter
- [PATCH v2 00/19] Make image fleecing more usable
- [PATCH RFC 0/8] blockdev-replace

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