Disaster Recovery and Ceph Block Storage

Introducing Multi-Site Mirroring

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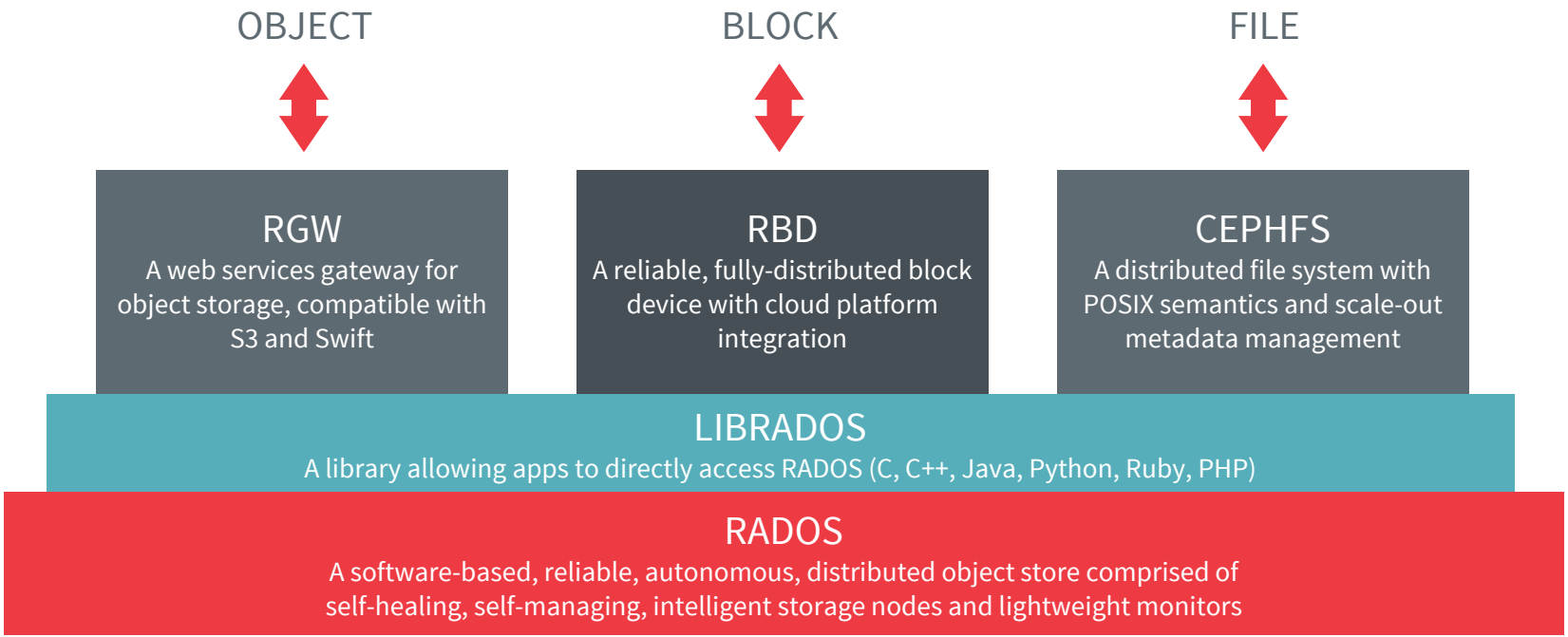
WHAT IS CEPH ALL ABOUT

- Distributed storage
- All components **scale horizontally**
- No single point of failure
- Software
- **Hardware agnostic**, commodity hardware
- Object, block, and file in a single cluster
- Self-manage whenever possible
- **Open source** (LGPL)

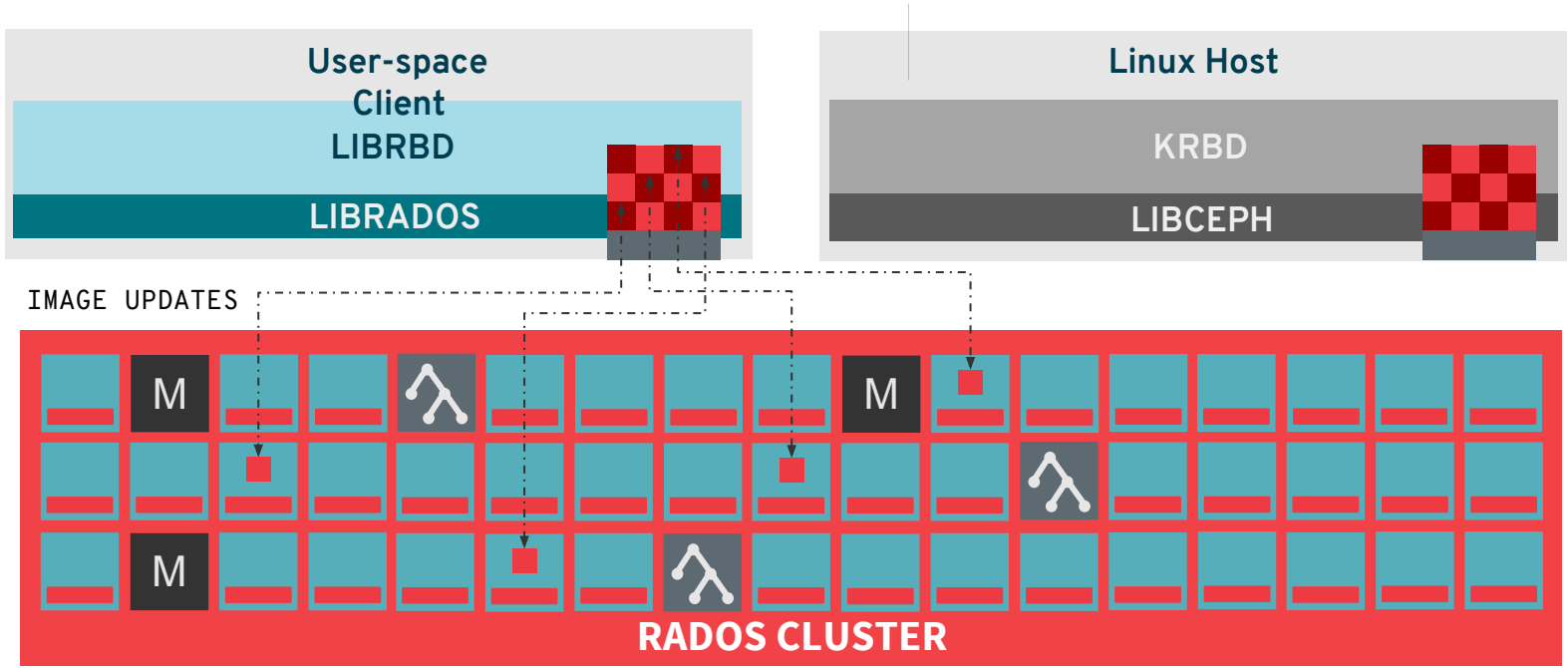
CEPH COMPONENTS



RADOS BLOCK DEVICE

- Block device abstraction
- Striped over fixed-size objects
- Highlights
  - Broad integration
  - Thinly provisioned
  - Copy-on-write clones
  - Snapshots

RADOS BLOCK DEVICE



MOTIVATION

- Massively scalable and fault tolerant design
- What about data center failures?
  - Data is the “special sauce”
  - Failure to plan is planning to fail
- Snapshot-based incremental backups
- Desire online, continuous backups
  - a la RBD Mirroring

MIRRORING DESIGN PRINCIPLES

- Replication needs to be asynchronous
  - IO shouldn’t be blocked due to slow WAN
  - Support transient connectivity issues
- Replication needs to be crash consistent
  - Respect write barriers
- Easy management
- Expect failure can happen anytime

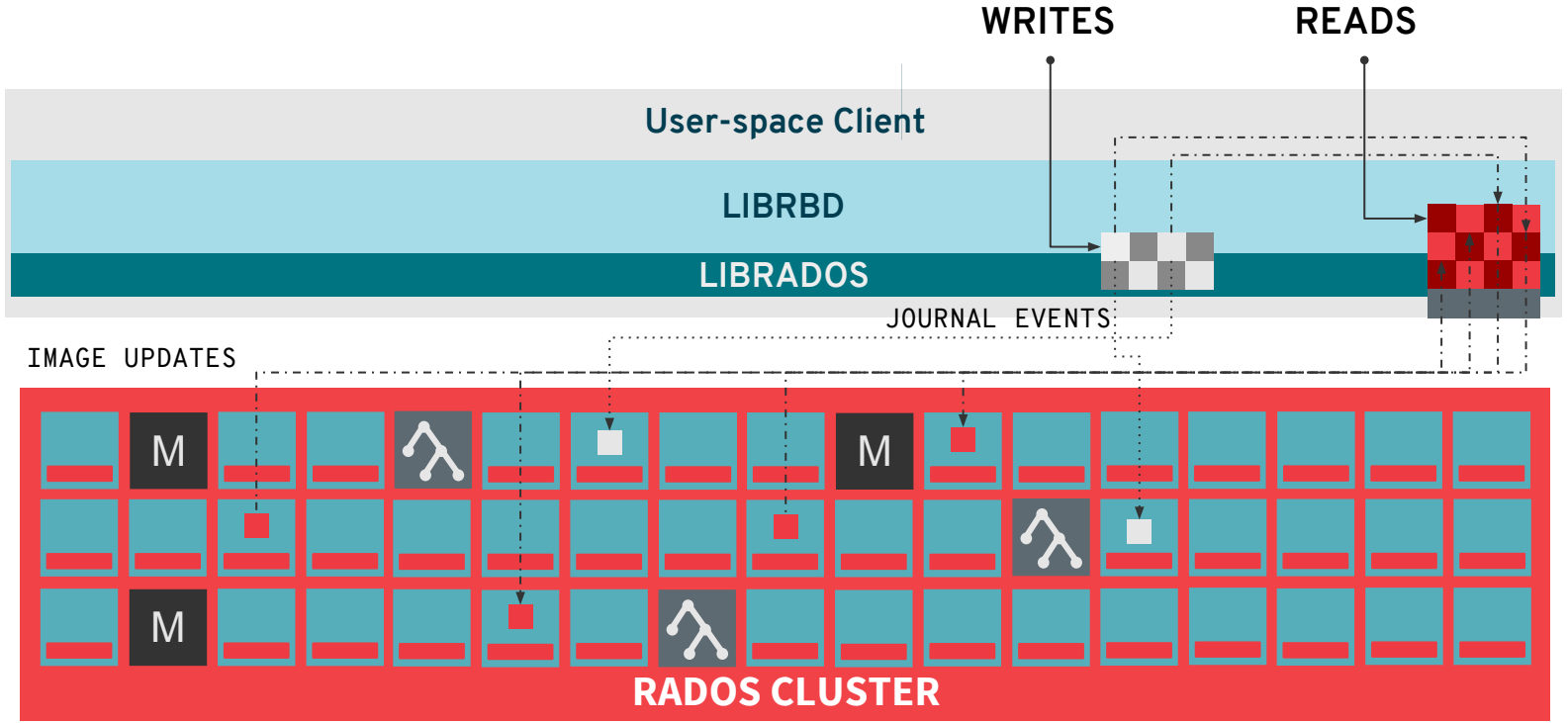
MIRRORING DESIGN FOUNDATION

- Journal-based approach to log all modifications
- Support access by multiple clients
- Client-side operation
- Event logs appended into journal objects
- Delay all image modifications until event safe
- Commit journal events once image modification safe
- Provides an ordered view of all updates to an image

JOURNAL DESIGN

- Typical IO path with journaling:
  a. Create an event to describe the update
  b. Asynchronously append event to journal object
  c. Update in-memory image cache
  d. Blocks cache writeback for affected extent
  e. Completes IO to client
- Unblock writeback once event is safe

JOURNAL DESIGN



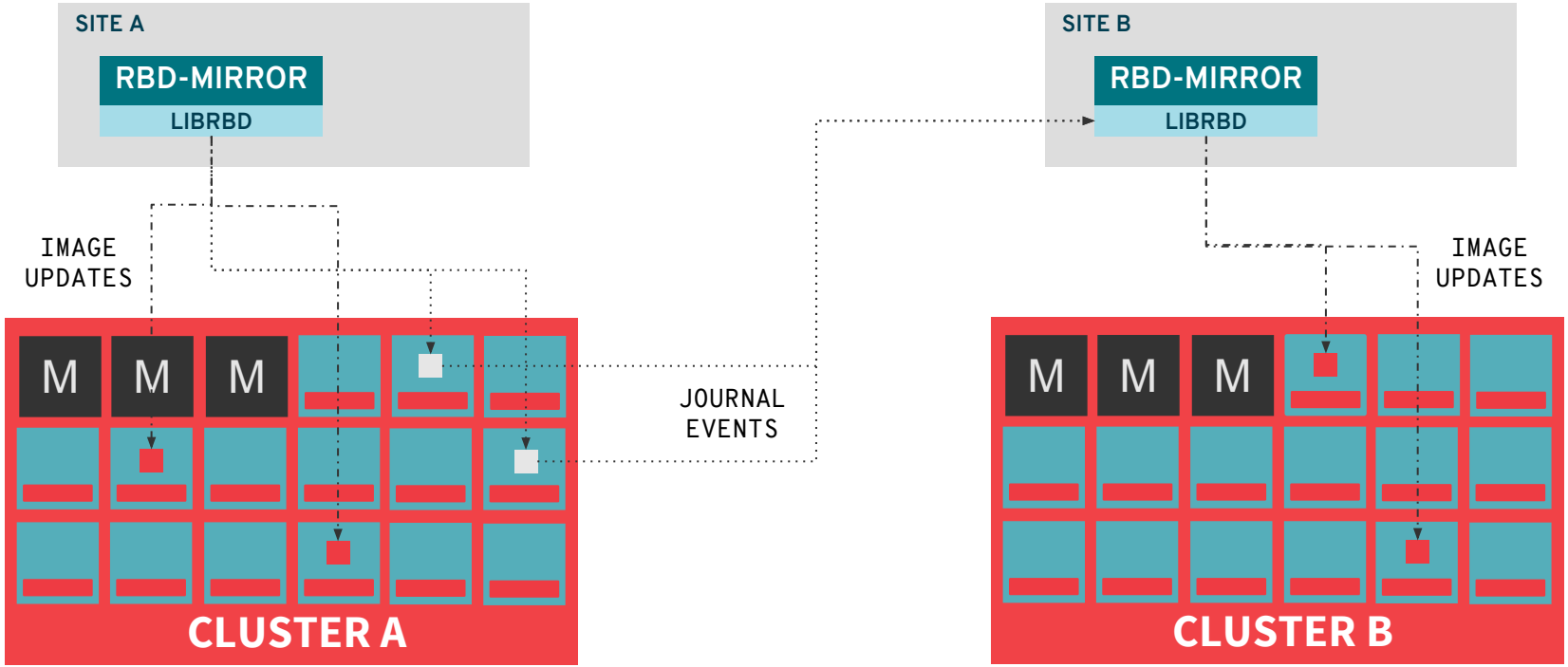
MIRRORING OVERVIEW

- Mirroring peers are configured per-pool
- Enabling mirroring is a per-image property
- Requires that the journal image feature is enabled
- Image is primary (R/W) or non-primary (R/O)
- Replication is handled by rbd-mirror daemon

RBD-MIRROR DAEMON

- Requires access to remote and local clusters
- Responsible for image (re)sync
- Replays journal to achieve consistency
  - Pulls journal event from remote cluster
  - Applies event to local cluster
  - Commits journal event
  - Trim journal
- Transparently handles failover/failback
- Two-way replication between two sites
- One-way replication between N sites

RBD-MIRROR DAEMON



MIRRORING SETUP

- Deploy rbd-mirror daemon on each cluster
  - Jewel/Kraken only support single active daemon per-cluster
- Provide uniquely named “ceph.conf” for each remote cluster
- Create pools with same name on each cluster
- Enable pool mirroring (rbd mirror pool enable)
- Specify peer cluster via rbd CLI (rbd mirror pool peer add)
- Enable image journaling feature (rbd feature enable journaling)
- Enable image mirroring (rbd mirror image enable)

SITE FAILOVER

- Per-image failover / failback
- Coordinated demotion / promotion
  - (rbd mirror image demote)
  - (rbd mirror image promote)
- Uncoordinated promotion + resync
  - (rbd mirror image promote --force)
- Resync from force-promotion / split-brain
  - (rbd mirror image resync)

CAVEATS

- Write IOs have worst-case 2x performance hit
  - Journal event append
  - Image object write
- In-memory cache can mask hit if working set fits
- Only supported by librbd-based clients

MITIGATION

- Use a small SSD/NVMe-backed pool for journals
  - ‘rbd journal pool = <fast pool name>’
- Batch multiple events into a single journal append
  - ‘rbd journal object flush age = <seconds>’
- Increase journal data width to match queue depth
  - ‘rbd journal splay width = <number of objects>’
- Potentially parallelize journal append + image write between write barriers

FUTURE FEATURES

- Active/Active rbd-mirror daemons
- Deferred replication and deletion
- “Deep Scrub” of replicated images
- Smarter image resynchronization
- Improved health status reporting
- Improved pool promotion process

BE PREPARED

- Incorporate “failure by design”
- Ceph now provides the tools for full-scale disaster recovery
- Workloads can seamlessly relocate between geographic sites

Questions?

THANK YOU!

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