Ceph iSCSI Gateway

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Part 1: Background Foundation

How to use Ceph storage via iSCSI

First, some background …

- Ceph makes HA storage available in several ways:
  - As a block device
  - As a RESTful (web) service
  - Others (will detail soon)
- iSCSI allows remote access of storage via TCP/IP
  - Storage devices or device servers are called *Targets*
    - Can export a block device as an iSCSI target, using the ***LIO*** package
  - Clients are called *Initiators*
    - Available in Linux via the open-iscsi package

How to use Ceph storage via iSCSI

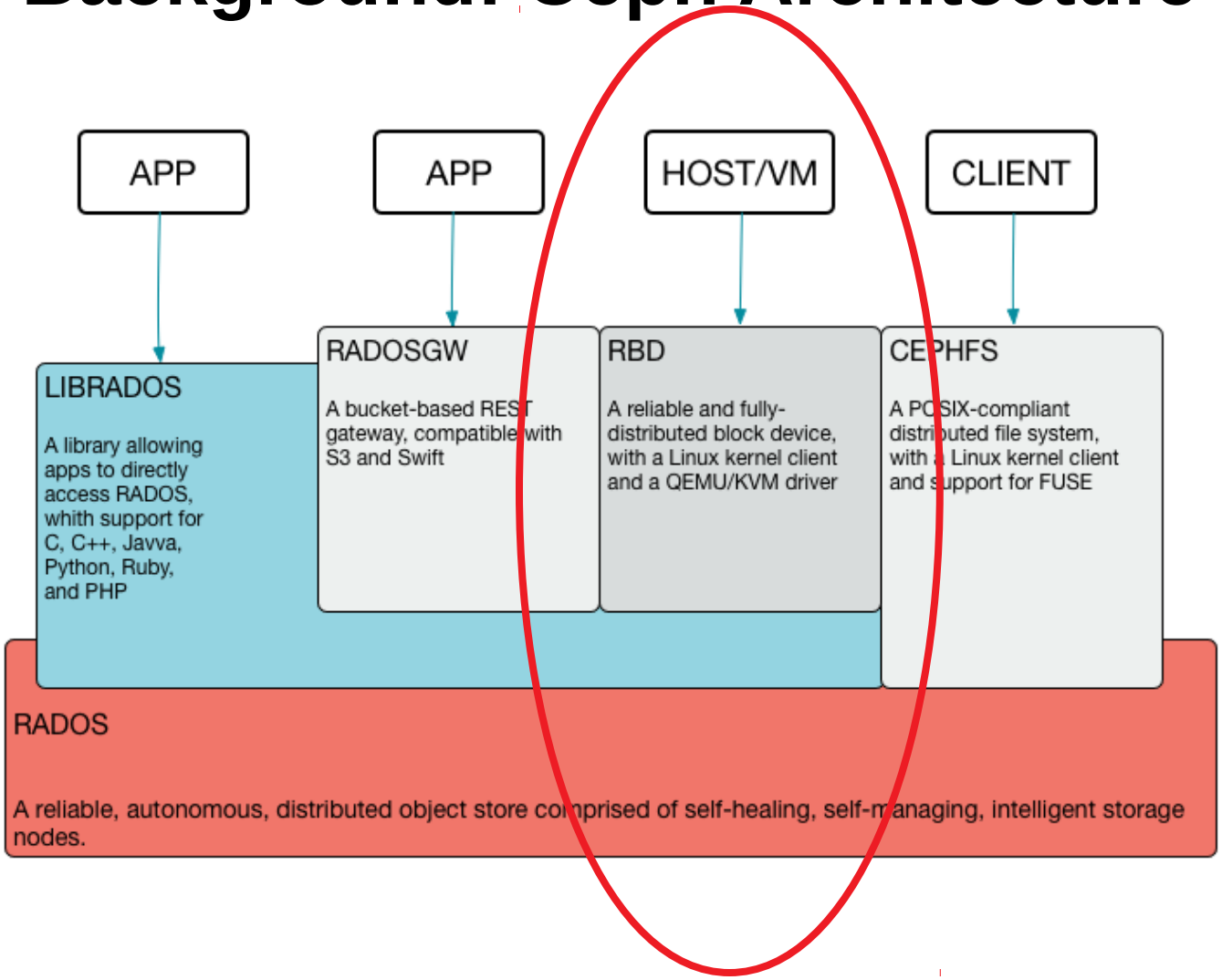
How to combine the reliability of Ceph with the popular iSCSI (Storage over TCP/IP) protocol?

That's what this talk is about!

Background: Ceph Architecture

- Clustering technology, so failure resistant/**HA**
- Available in SUSE Enterprise Storage
- Makes a pool of HA storage available via different access methods, such as:
  - RGW: RADOS Gateway – for RESTful access
  - librados – roll your own application
  - CephFS – not used very much yet
  - RBD: RADOS Block Device – looks like a local storage device
    - This is the one we care about today

Background: Ceph Architecture



Ceph RADOS Block Device Features

- Block device backed by RADOS objects
  - Objects replicated across Ceph **OSDs**
- Thin provisioned
- Online resizable
- Supports snapshots and clones

- Linux kernel or librbd clients
  - Usage restricted to a subset of operating systems and applications
  - Features *can* lag behind RGW a bit (opinion)

Background: iSCSI Architecture

- Mechanism for transporting block storage traffic over a regular TCP/IP network
- iSCSI initiators (clients) communicate with iSCSI targets (servers)
- SCSI commands and responses encapsulated in iSCSI packets, inside TCP packets
- Remote storage appears on the iSCSI initiator as a local hard disk
  - Attach and format with XFS, NTFS, etc.
  - Boot from a remote target with an iSCSI capable network adapter or boot loader

Previous Method for iSCSI and RBD: “Roll your own”

- On *Target* system:
  - RBD converts Ceph protocol to/from Block Device
  - LIO converted block device to/from iSCSI
  - Block Device is an intermediate format: wasteful?

- On *Initiator* system:
  - Client access local block device
  - iSCSI initiator converts iSCSI to/from Block Device
  - This is okay, because iSCSI is designed to do this

Previous Method for iSCSI and RBD: “Roll your own”

- Problems with using the current Block Layer
  - Doesn't support *atomic compare and write*
  - Doesn't support *Persistent Group Reservations*
- Needed for Active/Active Multipath IO (*mpio)* iSCSI Gateway
- Until Block Layer supports these, we need a different approach

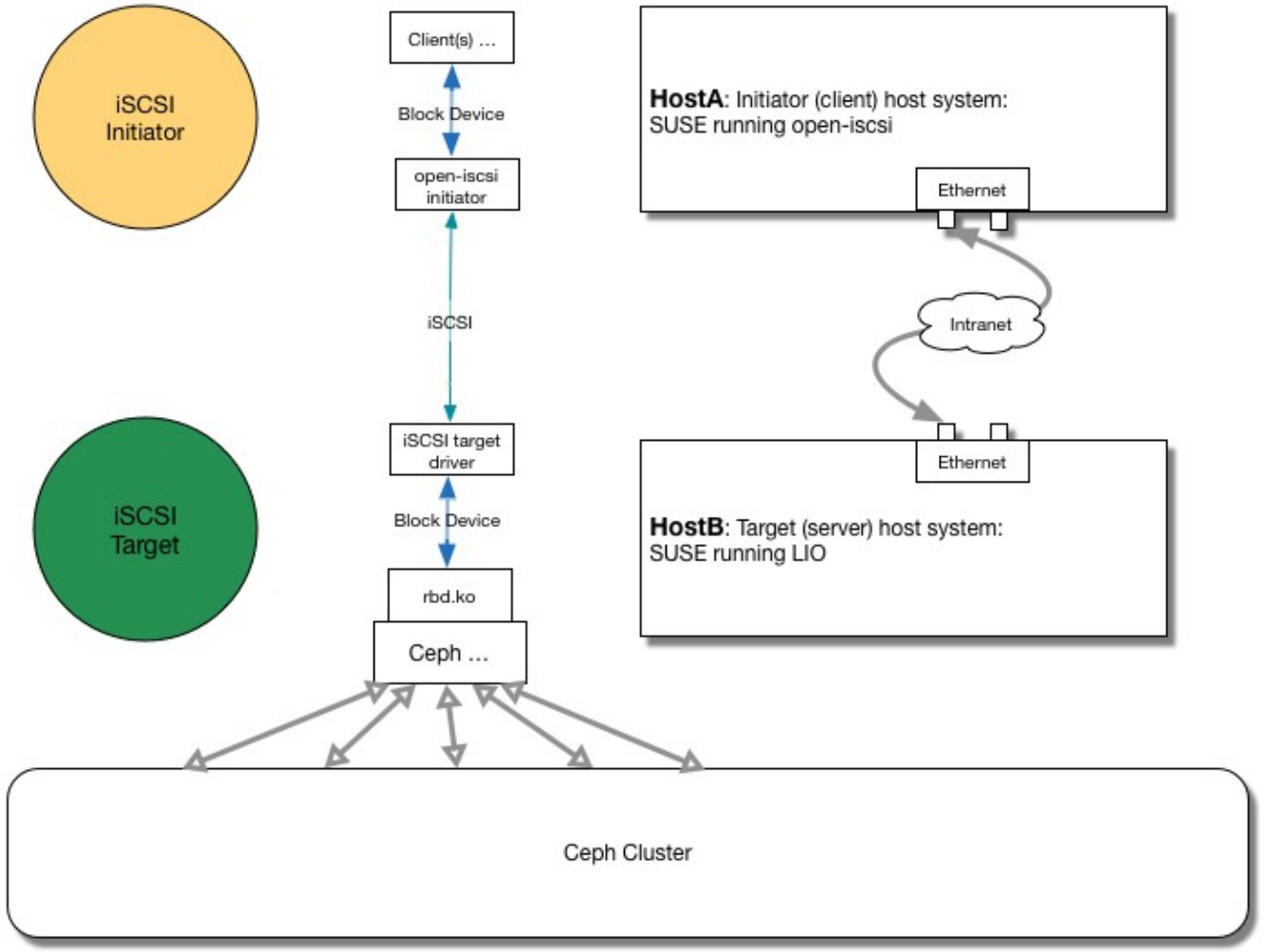
Updated Method for iSCSI and RBD: The iSCSI gateway for RBD

- Expose benefits of Ceph RBD to other systems
  - No requirement for Ceph-aware applications or operating systems
- Standardized iSCSI interface
  - Mature and trusted protocol (RFC 3720)
- iSCSI initiator implementations are widespread
  - Provided with most modern operating systems
  - Open-iscsi is the most common initiator on Linux
- The iSCSI target uses the LIO driver

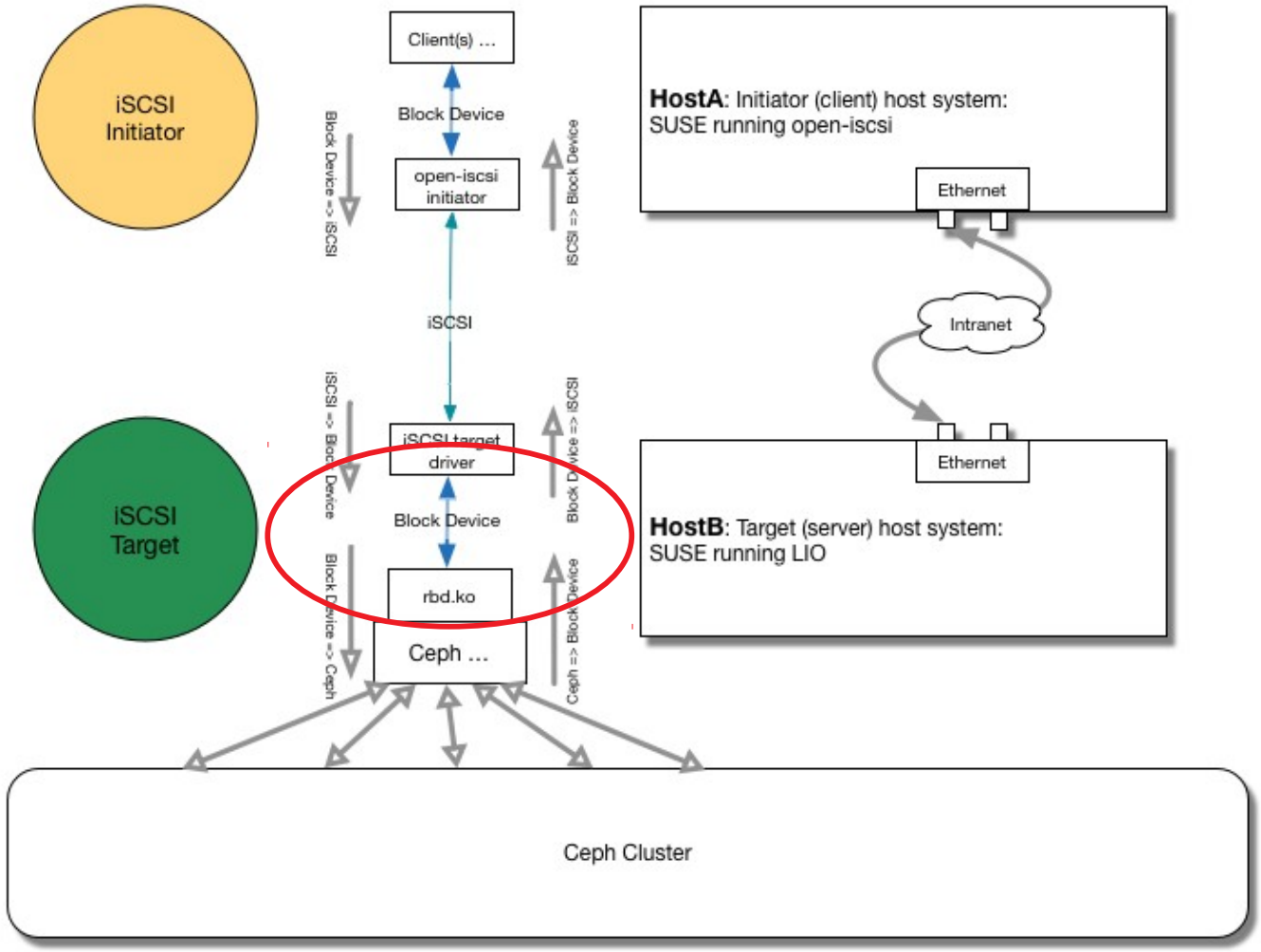
The iSCSI LIO Target

- LIO – Linux IO Target
- In kernel SCSI target implementation
  - Support for a number of SCSI transports
  - Pluggable storage backend
  - Is the current *“preferred”* iSCSI Linux target
- Flexible configuration
  - Uses the ***targetcli*** utility: like a shell

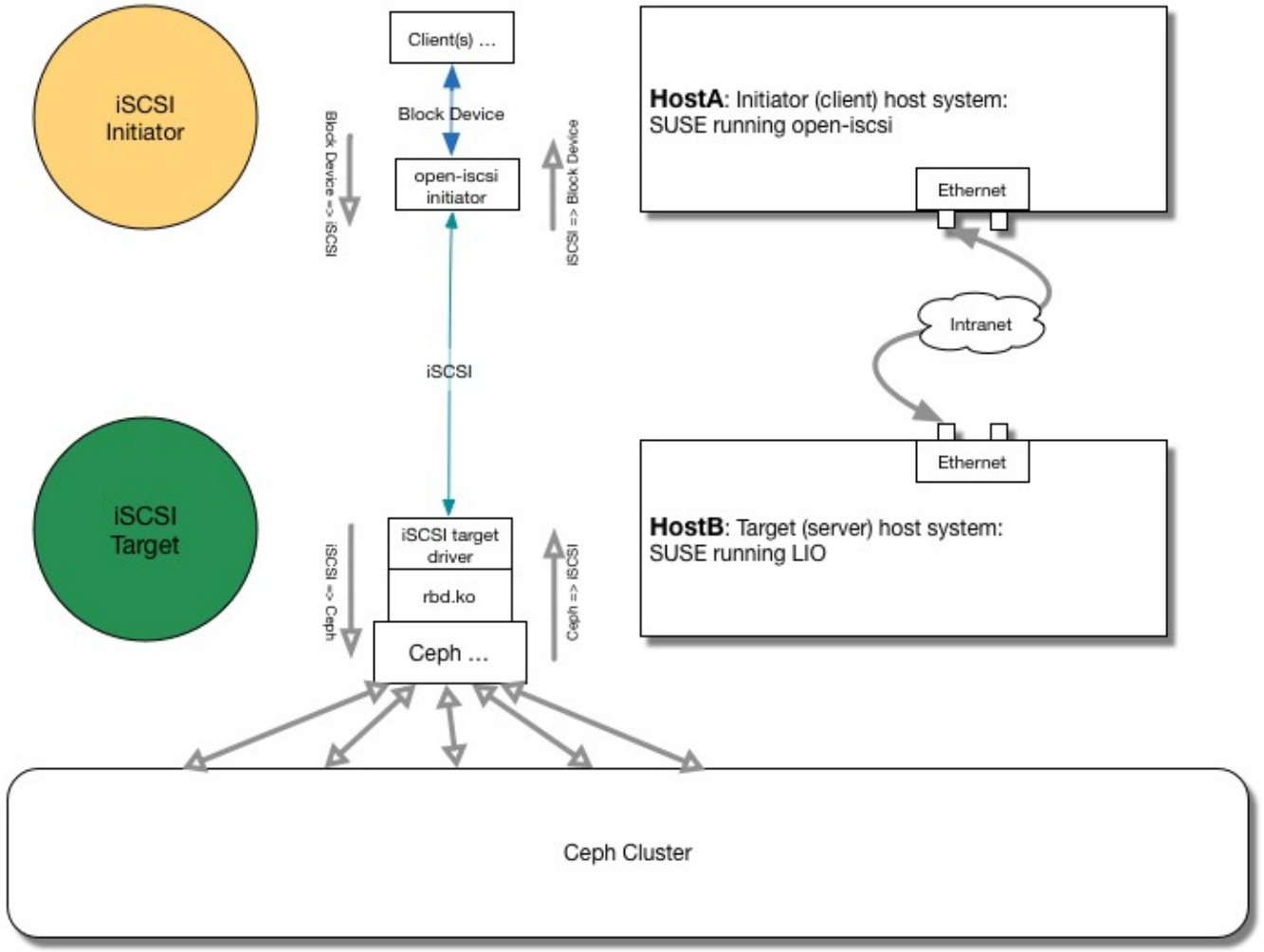
Current Approach: iSCSI and RBD



Current Approach: iSCSI and RBD



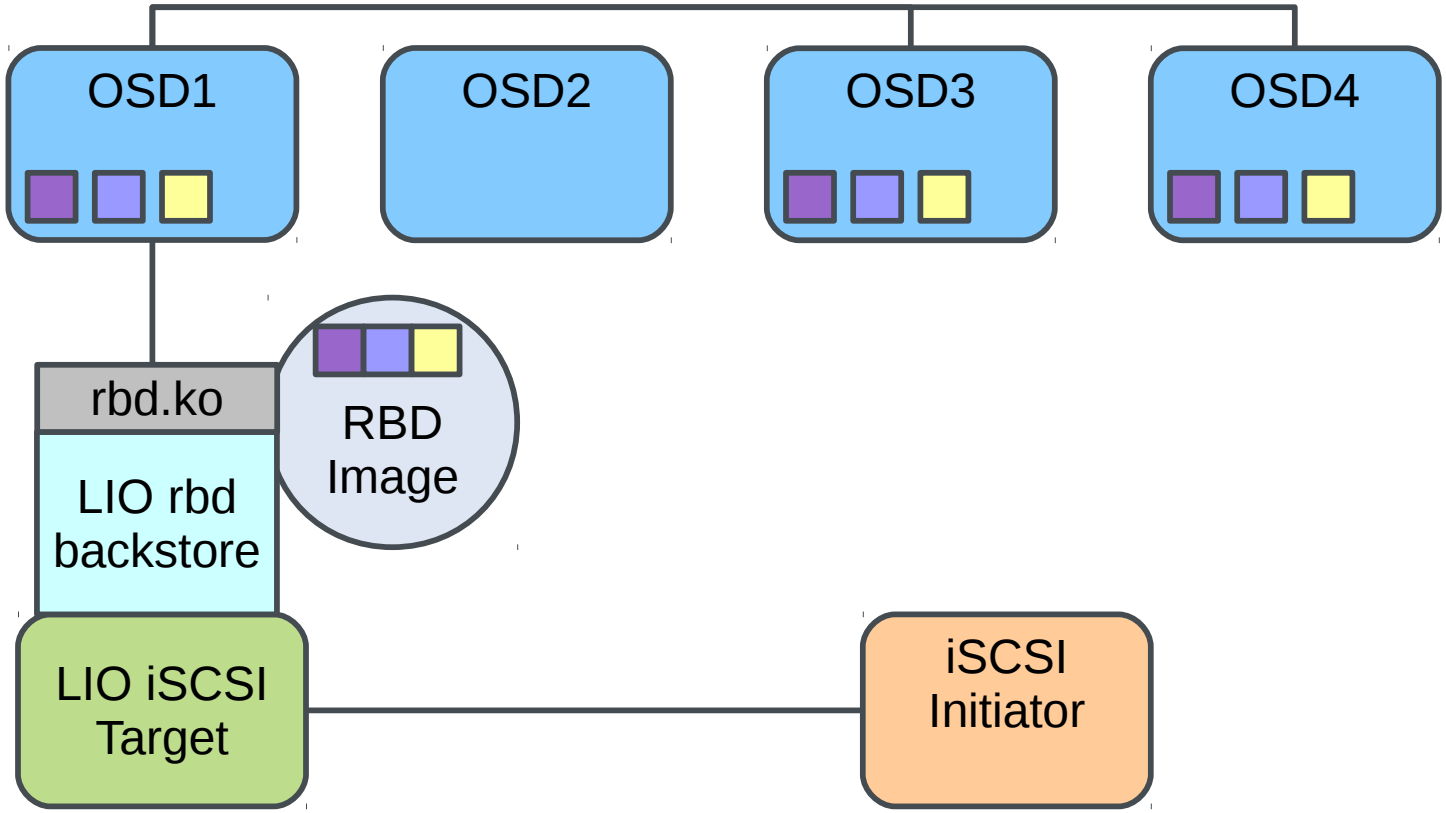
Updated Approach: iSCSI and RBD



Part 2: More Detail

RBD iSCSI gateway

The Ceph View



RBD iSCSI gateway

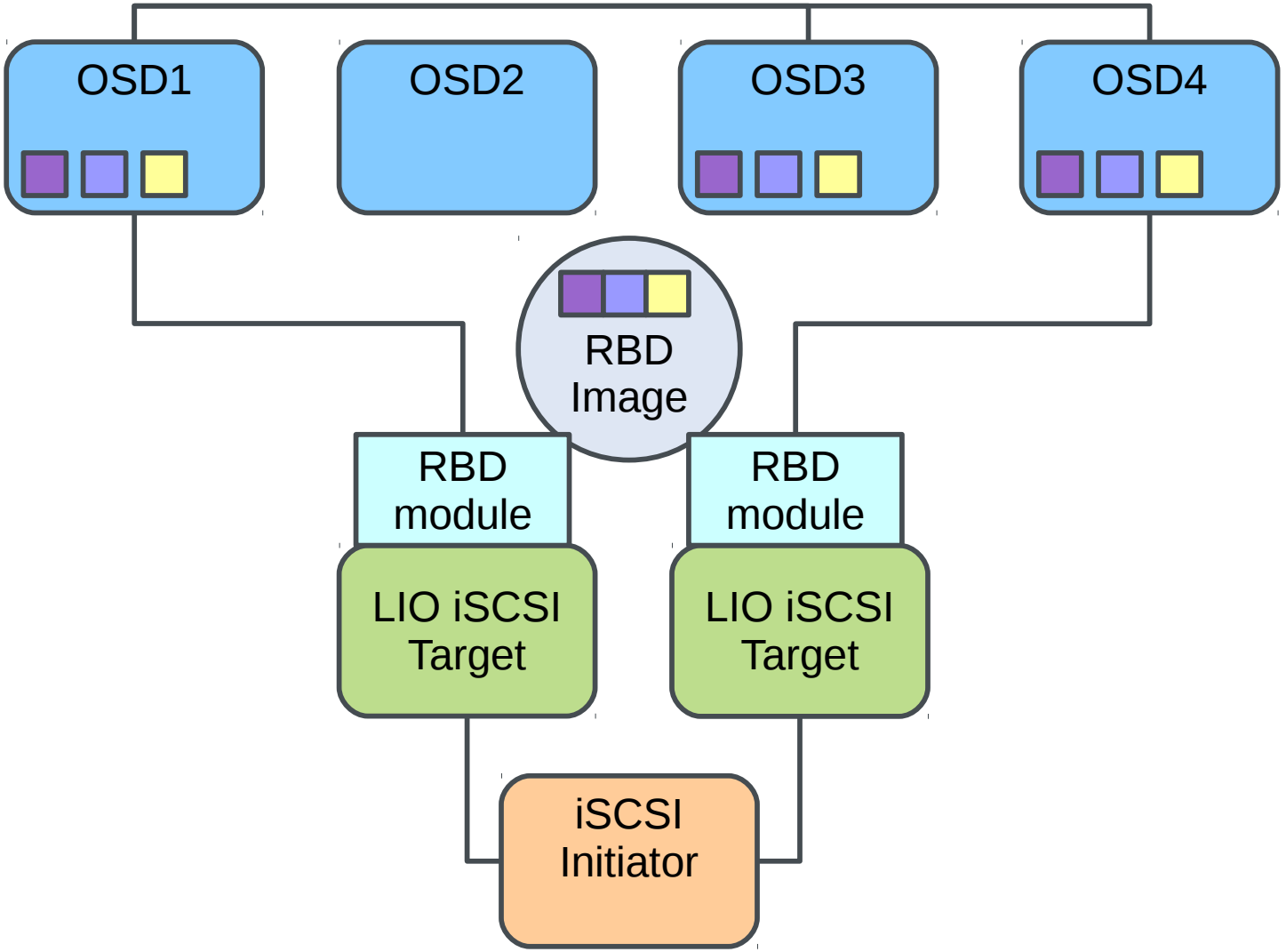
- LIO target configured with iSCSI transport fabric
- RBD *backstore* module
  - Translates SCSI IO into Ceph OSD requests
  - Special handling of operations that require exclusive device access
    - Atomic COMPARE AND WRITE, WRITE SAME and reservations
- lrbd: Multi-node configuration utility
  - Applies iSCSI target configuration across multiple gateways via *targetcli*

RBD iSCSI gateway
Multipath Support

- Allows for initiator access via redundant paths
  - iSCSI gateway node with multiple network adapters
    - Protection from a single network adapter failure
  - Multiple iSCSI gateways exporting same RBD image
    - Protection from entire gateway failure
- Initiator responsible for utilization of redundant paths
  - Available paths advertised in iSCSI discovery exchange
  - May choose to round-robin the IO, or to failover/failback

LIO using RBD iSCSI gateway

Multipath Support



RBD iSCSI gateway
Optimizations

- Efficient handling of certain SCSI operations
  - Offload RBD image IO to OSDs
    - Avoid locking on iSCSI gateway nodes
  - COMPARE AND WRITE
    - New *cmpext* OSD operation to handle RBD data comparison
    - Dispatch as compound *cmpext+write* OSD request
  - WRITE SAME
    - New *writesame* OSD operation to expand duplicate data at the OSD
  - Reservations
    - State stored as RBD image extended attribute
    - Updated using compound *cmpxattr+setxattr* OSD request

Configuration with lrbd

- Apply LIO configuration across multiple iSCSI gateway nodes
  - JSON configuration format
  - Targets, portals, RBD images and authentication information
- Configuration state stored in Ceph cluster
  - iSCSI gateway nodes apply configuration on boot

Configuration with lrbd

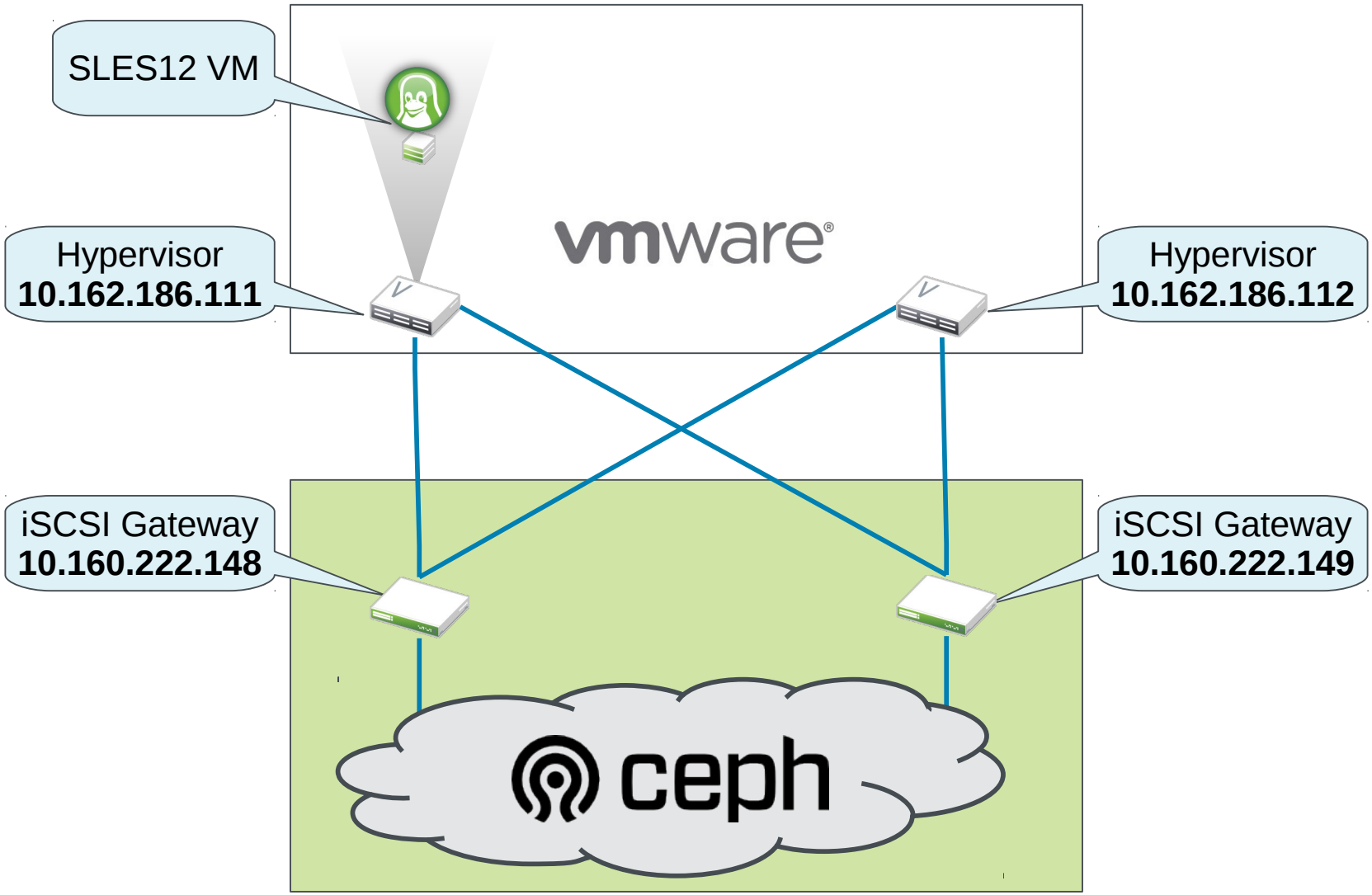
- *Targets* section
  - iSCSI gateway hosts
  - Target iSCSI Qualified Name (IQN)
- *Portals* section
  - IP addresses to utilize for iSCSI traffic
- *Pools* section
  - RBD images to expose
- *Auth* section
  - Access restrictions based on initiator name
  - CHAP credentials

Some iSCSI Initiators

- open-iscsi
  - Default iSCSI initiator shipped with SLES10 and later
  - Multipath supported in combination with dm-multipath
  - Available on most Linux distributions
- Microsoft iSCSI initiator
  - Installed by default from Windows Server 2008 and later
    - Not available on desktops
  - Supports MPIO in recent versions
- VMware ESX
  - Concurrent clustered filesystem (VMFS) access from multiple initiators

Demonstration

Demonstration Environment



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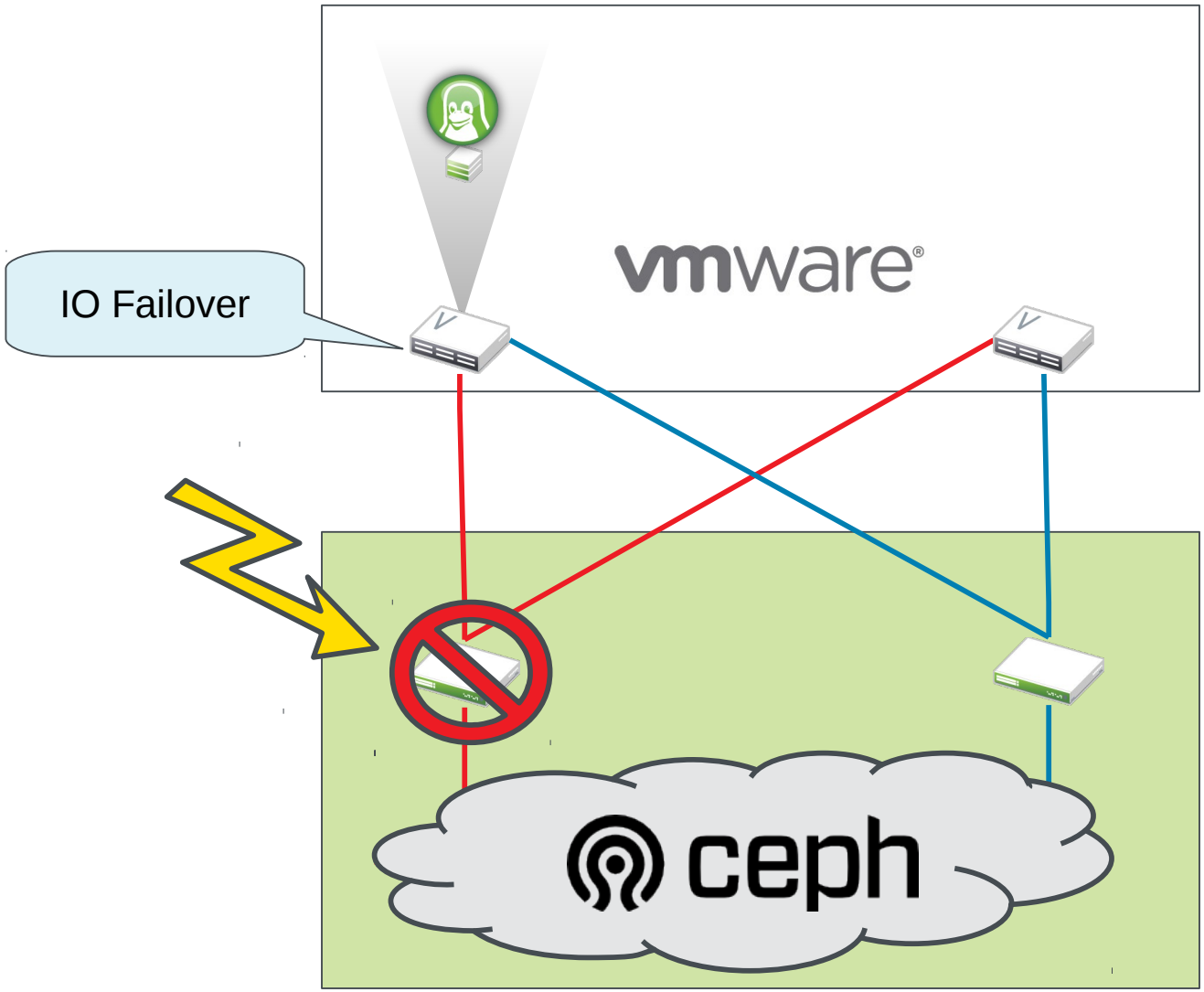

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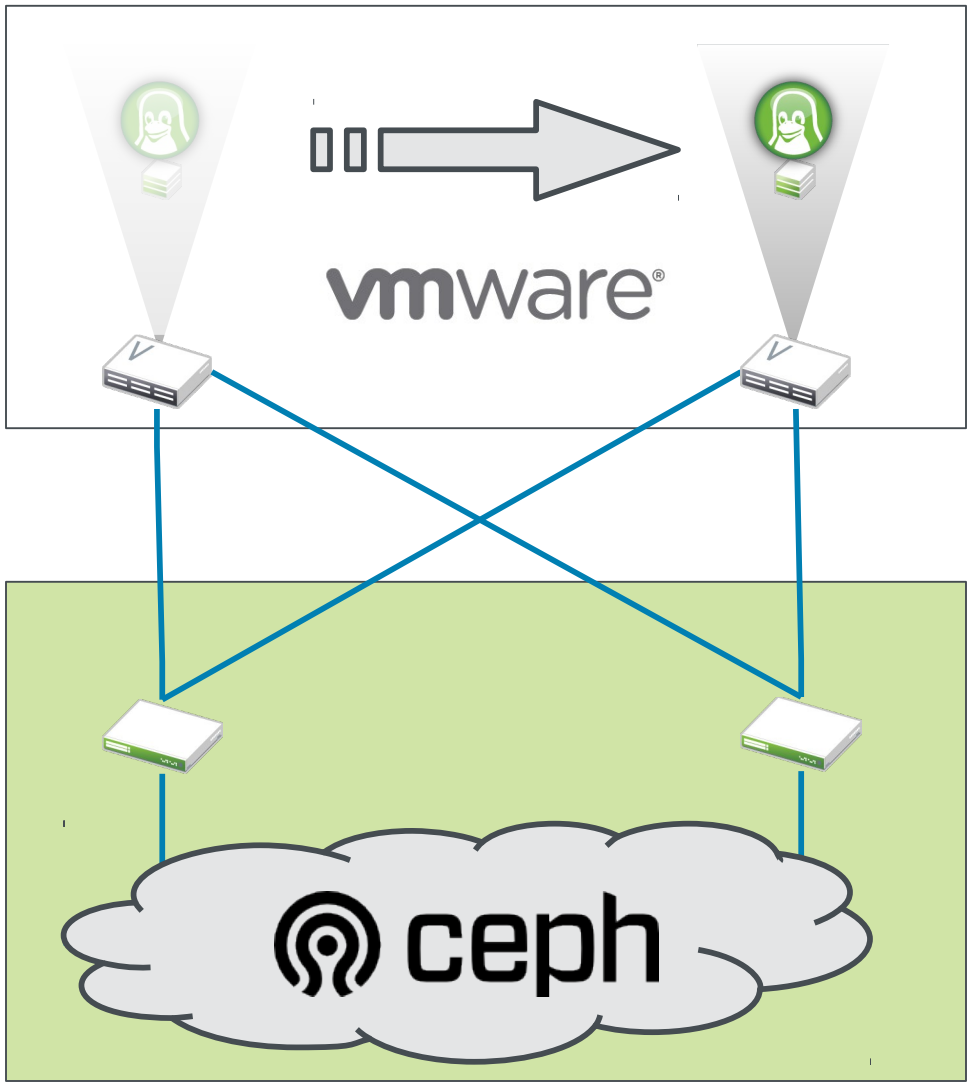

For More Information

- open-iscsi
  - RFC 3720: https://www.ietf.org/rfc/rfc3720.txt
  - URL: http://www.openiscsi.org
  - Discussion: openiscsi@googlegroups.com
- Ceph
  - General: http://ceph.com
  - Documentation: http://docs.ceph.com/0.80.5/
- SUSE Enterprise Storage
  - Product: https://www.suse.com/products/suse-enterprise-storage/
  - Documentation: https://www.suse.com/documentation/

Questions?

Thank you.

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