CEPH WORKSHOP

GridKA School 2015

Diana Gudu
Uros Stevanovic

September 8, 2015

Karlsruhe Institute of Technology

INTRODUCTION ROUND

DIANA GUDU

- PhD researcher in Computer Science @KIT (SCC)
  - distributed multi-agent framework for trading cloud resources
- working in HBP @SCC on cloud storage
- MSc in Computational Science and Engineering @TU Munich
- BSc in Computer Science @Polytechnic University of Bucharest

UROS STEVANOVIC

- working in AARC project @KIT (SCC)
- PhD @KIT (IPE): 2010-2015
  - building a custom smart camera framework
  - using FPGAs
  - implementing image processing algorithms
- studied Electrical Engineering @University of Belgrade

YOU

Your turn!

EVOLUTION OF STORAGE

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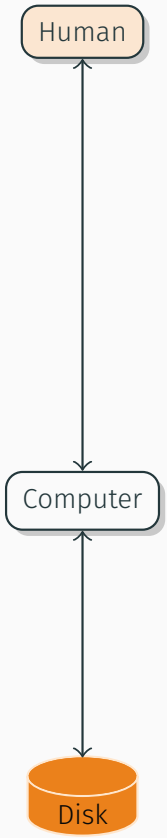

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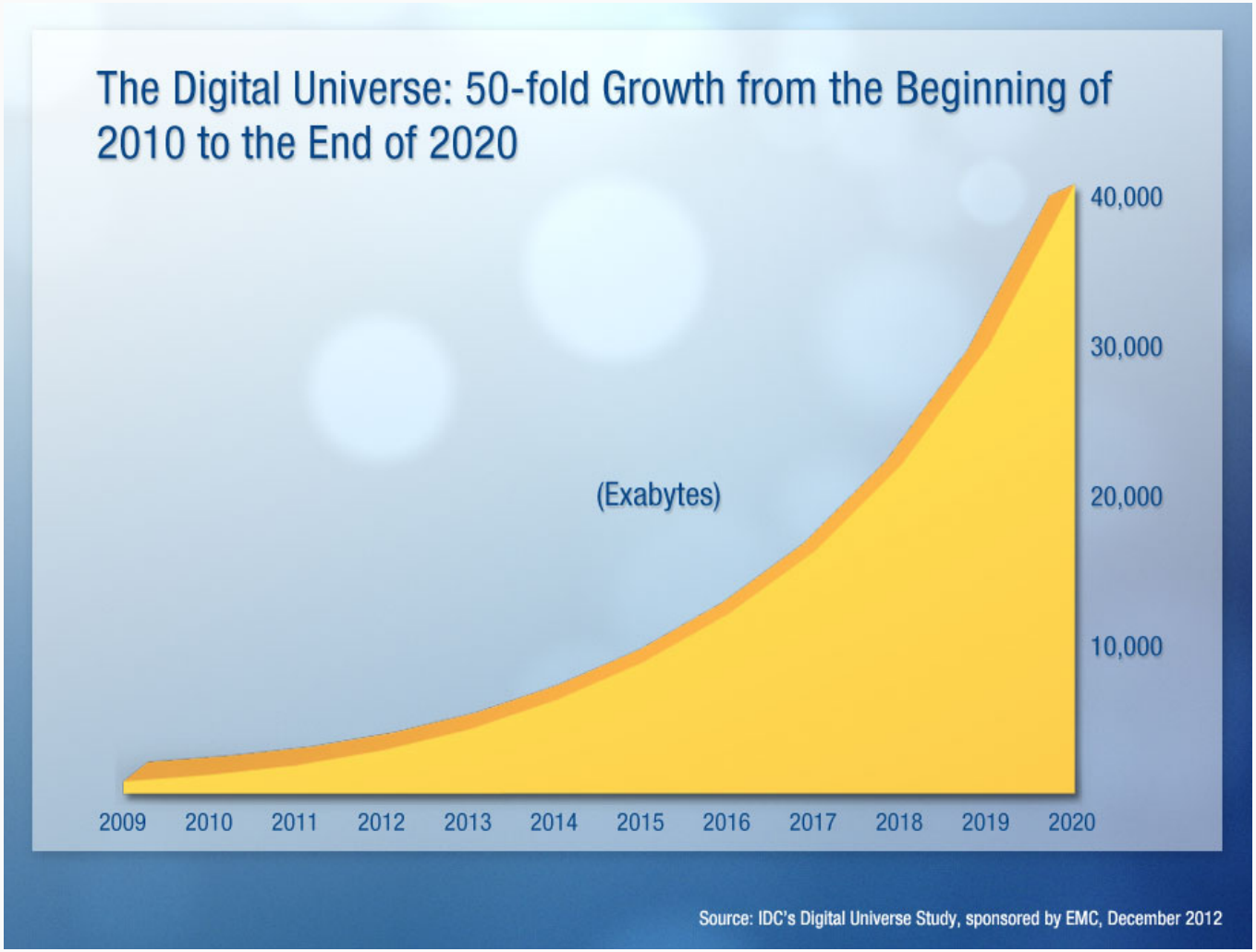

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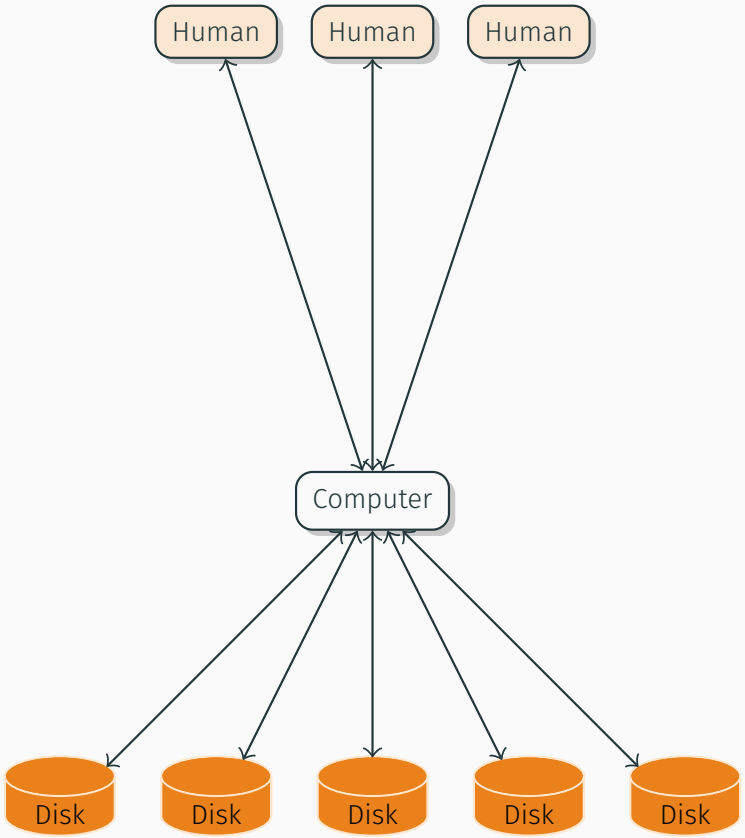

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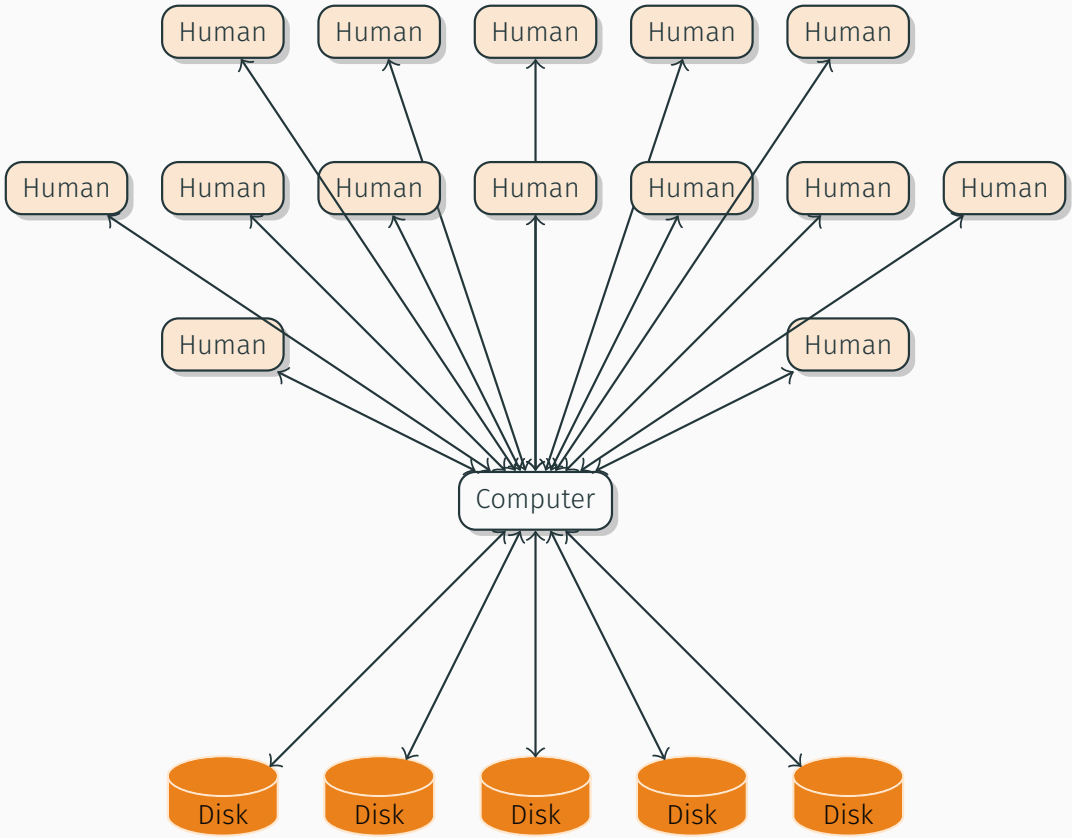

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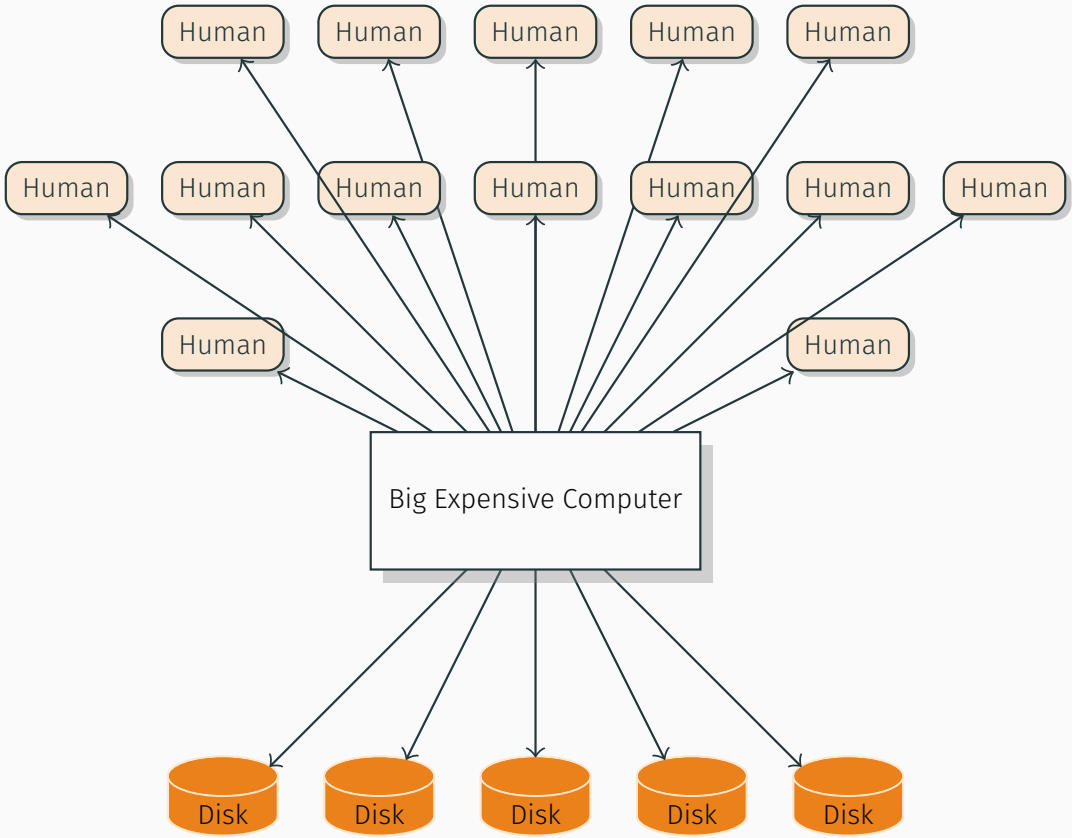

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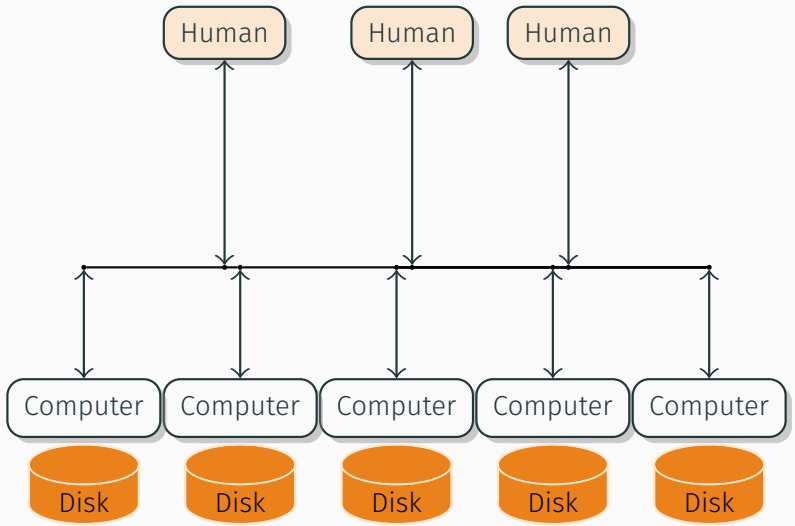

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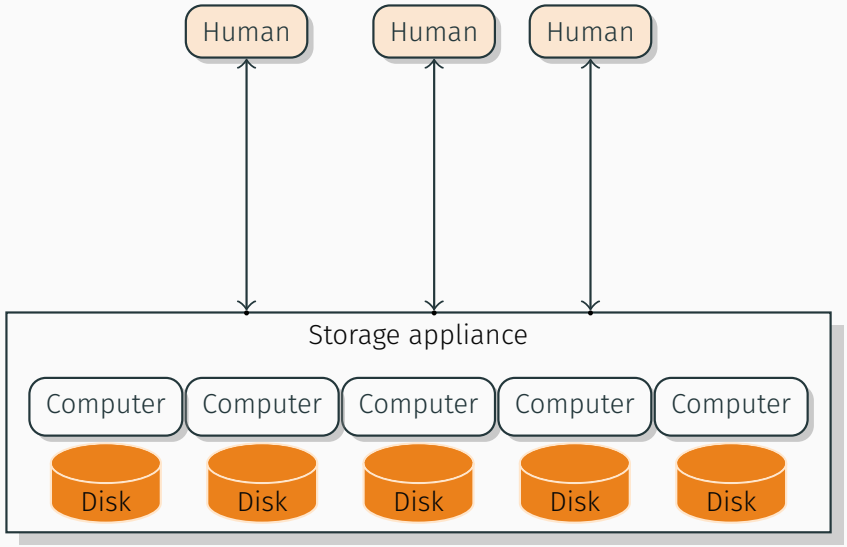
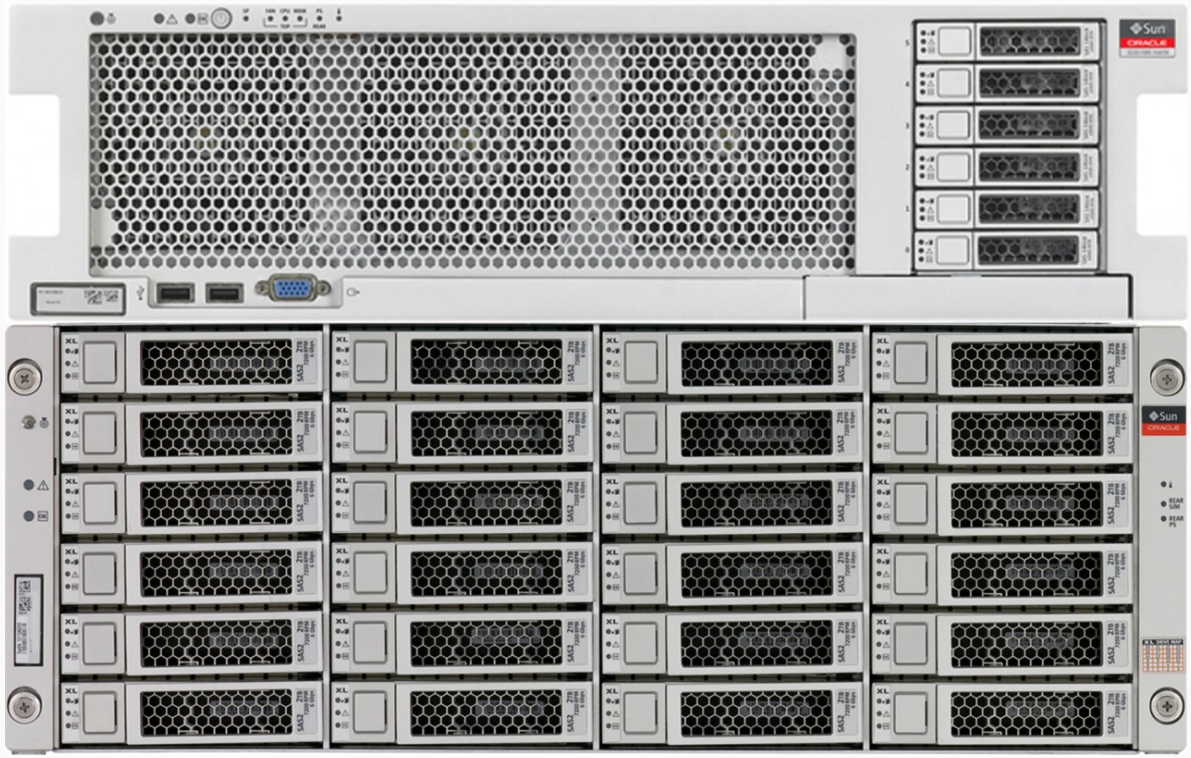
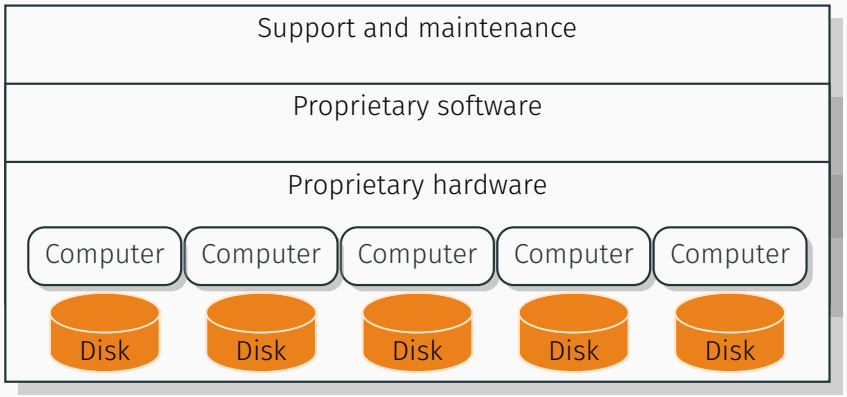


STORAGE APPLIANCE



Oracle http://www.e-business.com/zfs-7420-storage-appliance

FUTURE OF STORAGE



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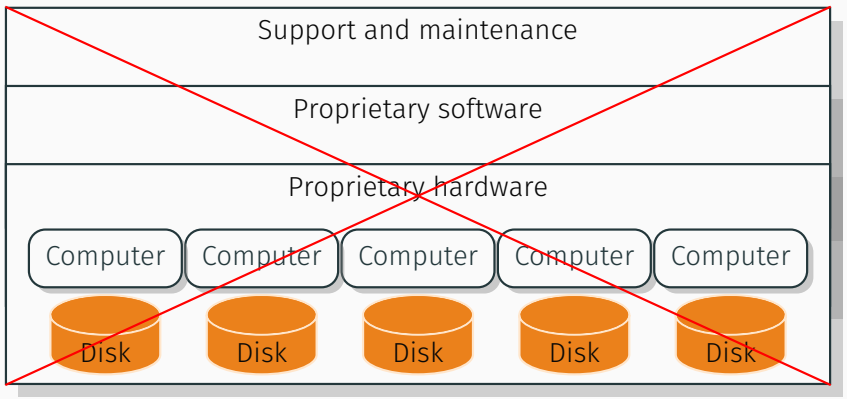

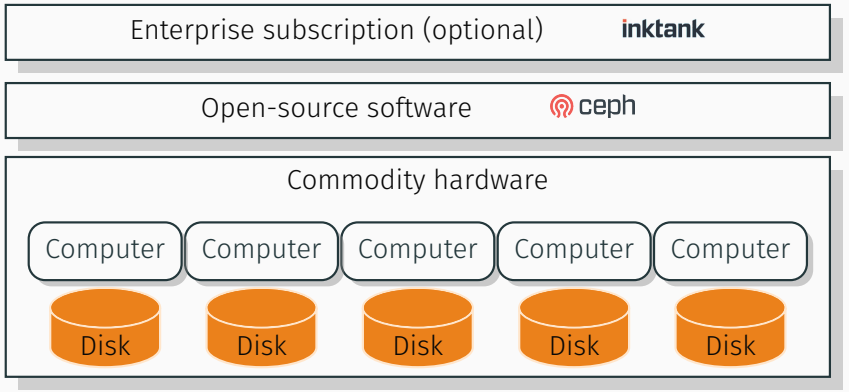

CEPH

Philosophy

- open-source

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- community focused

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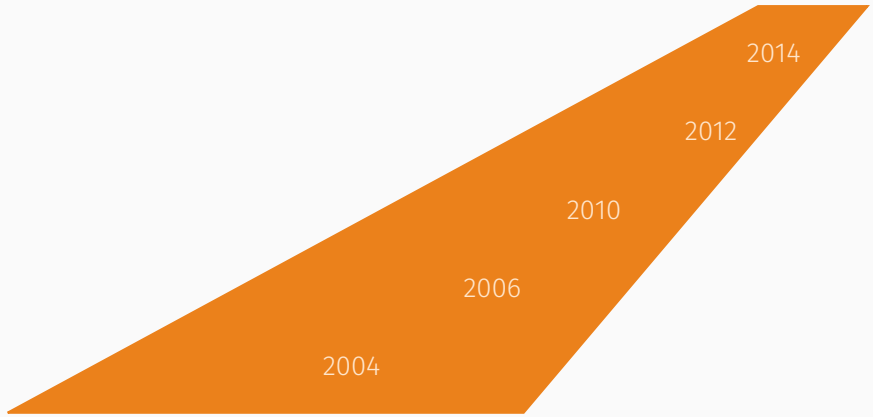

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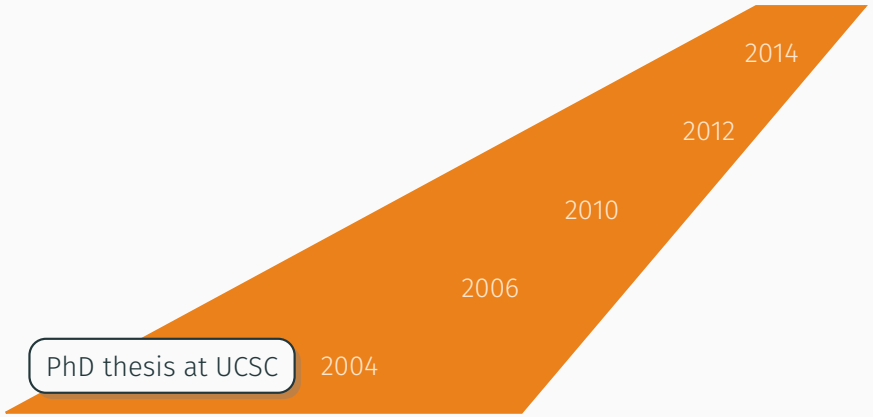

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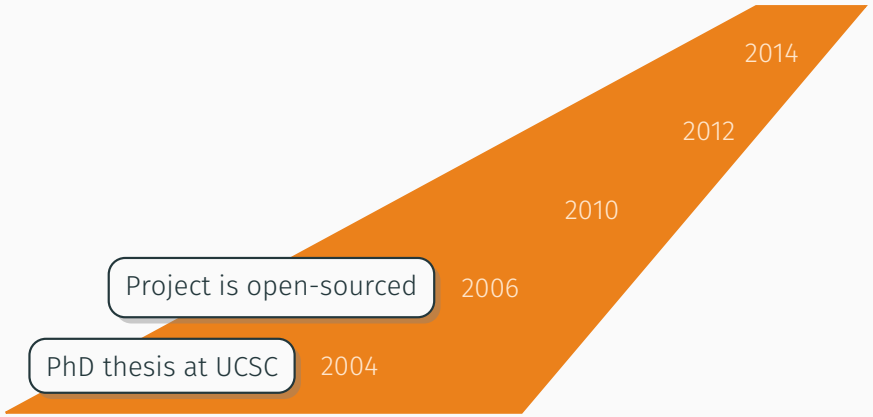

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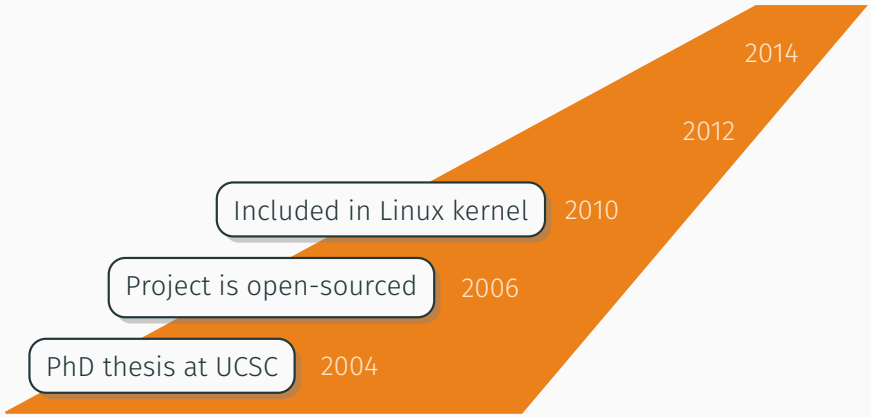

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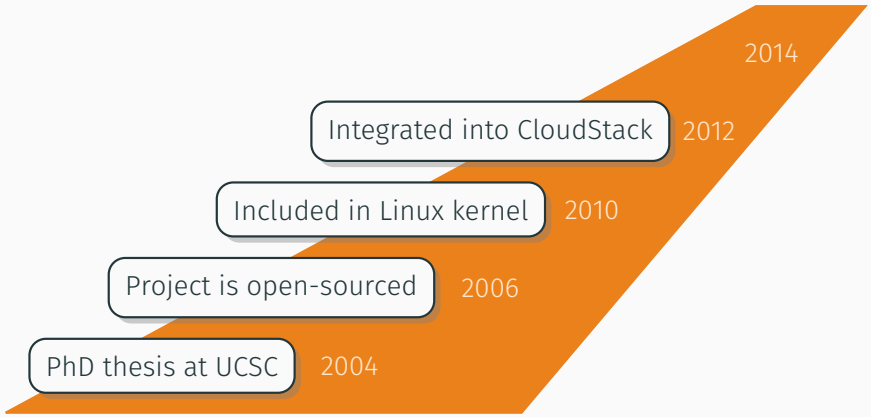

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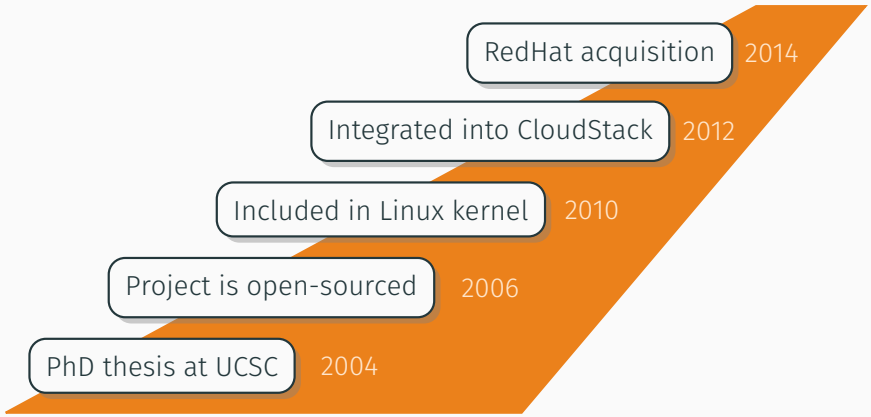
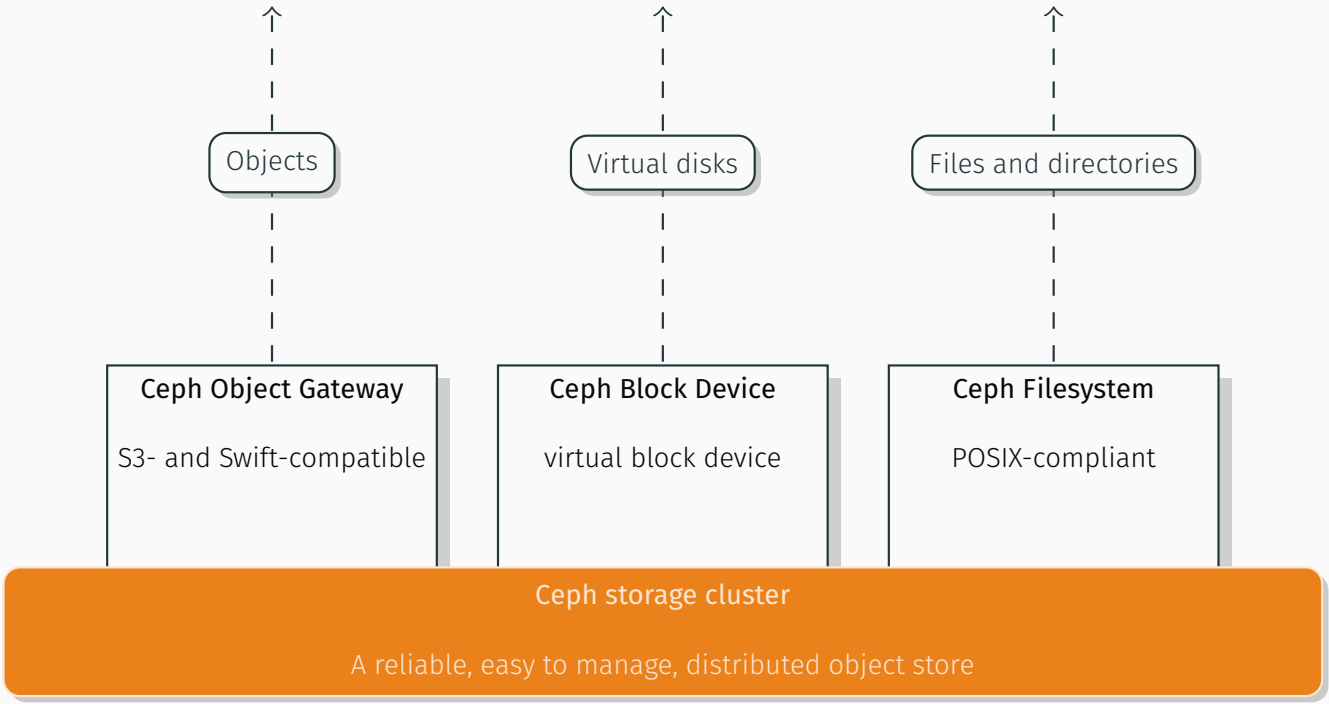


CEPH ARCHITECTURE



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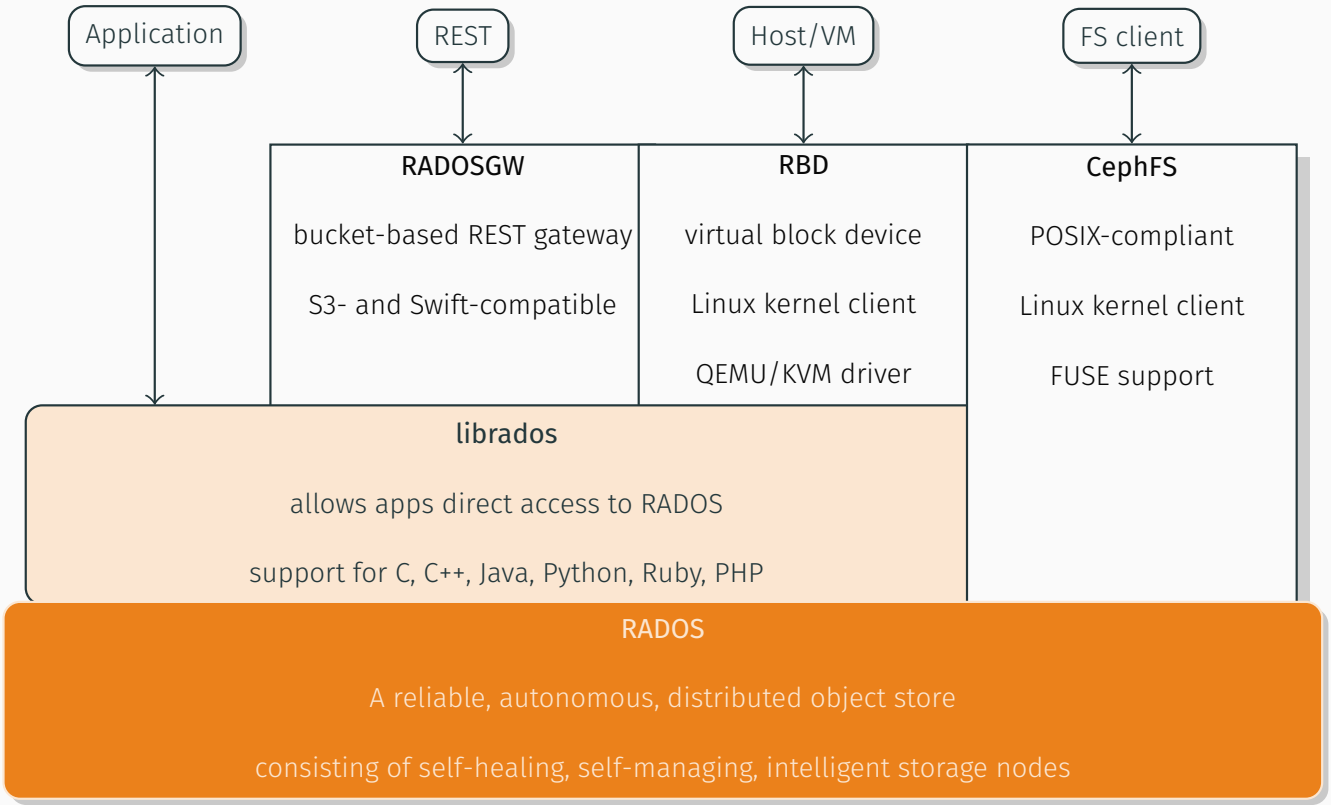
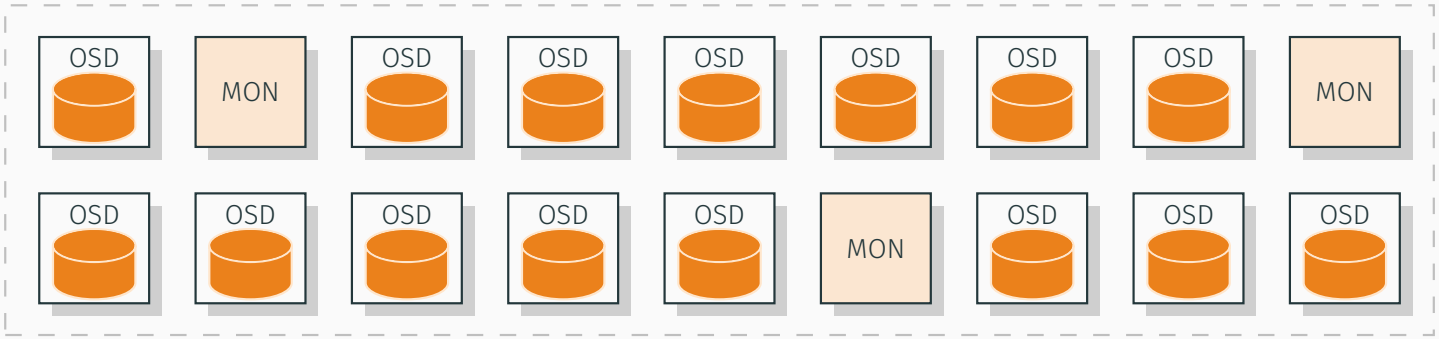


RADOS


OSD
MON
OSD
OSD
OSD
OSD
OSD
OSD
MON
OSD
OSD
OSD
OSD
OSD
MON
OSD
OSD
OSD

CEPH DAEMONS

OSD

- serve objects to clients
- one per disk
- backend: btrfs, xfs, ext4
- peer-to-peer replication and recovery
- write-ahead journal

MON

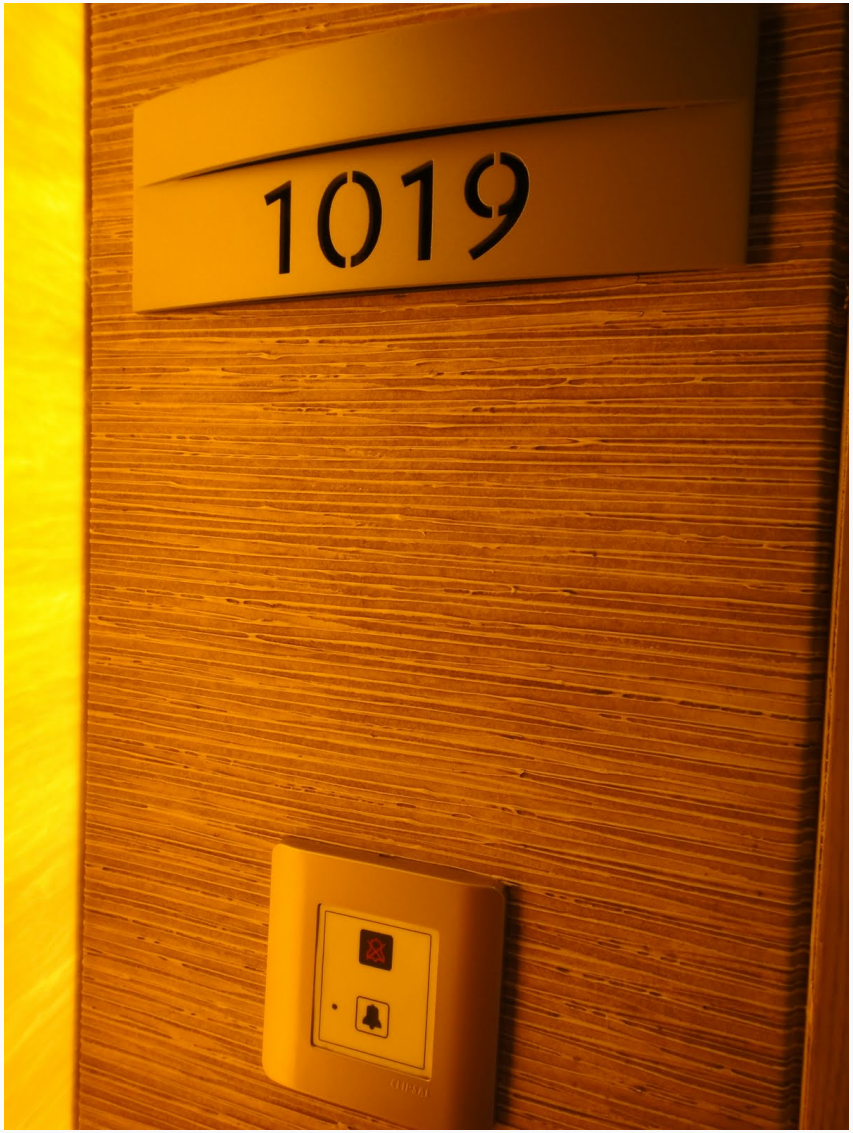
- maintain cluster state and membership
- vote for distributed decision-making
- small, odd number

DATA PLACEMENT

HOTELS

http://free-stock-illustration.com/hotel+key+card

HOTELS



http://2.bp.blogspot.com/-o-rlIrv094E/TXxj8D-B2LI/AAAAAAAAGh8/VEbrbHpxVxo/s1600/DSC02213.JPG

HOTELS

- What if the hotel had 1 billion rooms? Or ∞?

#13,565,983

What if the hotel changed constantly?

http://waltonian.com/news/eastern-library-renovations-continue/

Scale-up everything?

http://www.millenniumhotels.com/content/dam/global/en/the-heritage-hotel-manila/images/cons-photographics-lobby-reception-desk%2003062011_34-basicB-preview-2048.jpg

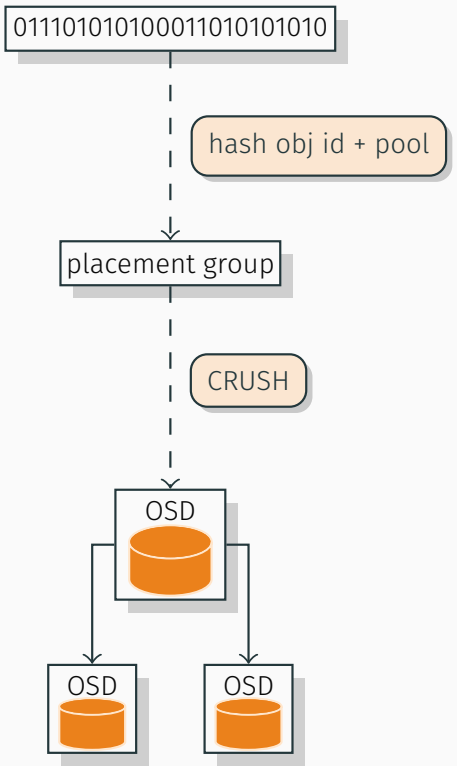
HOTELS

- The hotel itself must assign people to rooms instead of a centralized place
- The hotel should grow itself organically

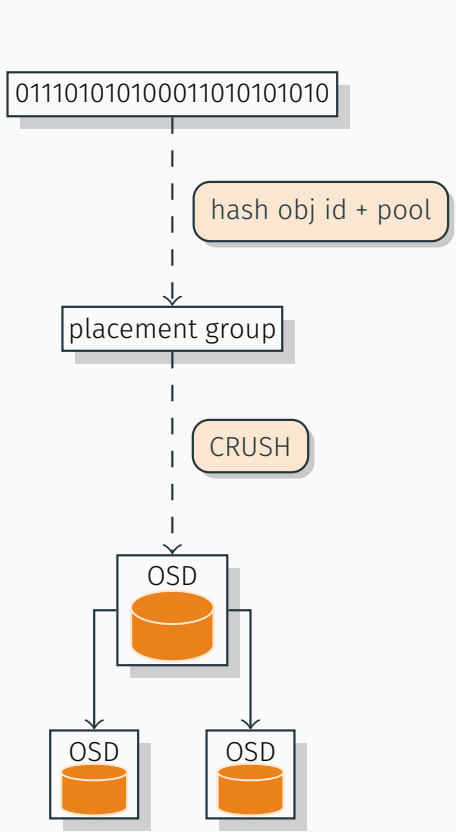
HOTELS

- The hotel itself must assign people to rooms instead of a centralized place
- The hotel should grow itself organically
- Deterministic placement algorithm
- Intelligent nodes

CRUSH


01110101010000110101010
hash obj id + pool
placement group
CRUSH
OSD
OSD
OSD

CRUSH


01110101010000110101010101010
hash obj id + pool
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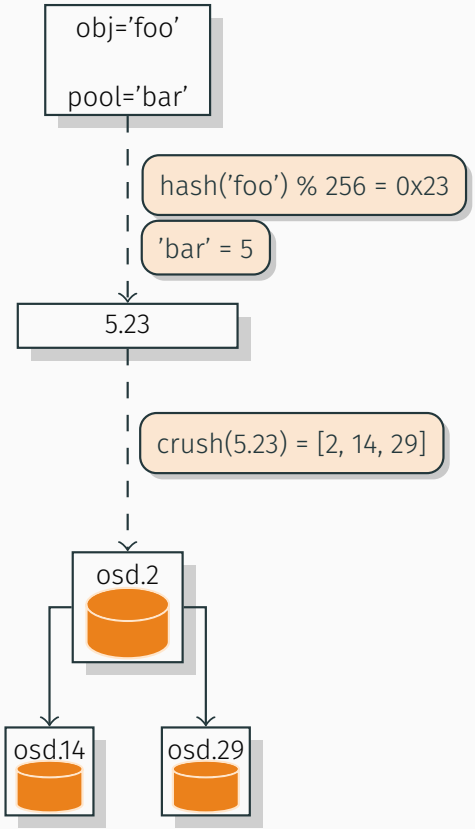
CRUSH
OSD
OSD
OSD


obj='foo'
pool='bar'
hash('foo') % 256 = 0x23
'bar' = 5
5.23
crush(5.23) = [2, 14, 29]
osd.2
osd.14
osd.29

Controlled Replication Under Scalable Hashing

- Pseudo-random placement algorithm
- Repeatable, deterministic
- Statistically uniform distribution
- Stable mapping: minimal data migration
- Rule-based configuration, topology aware

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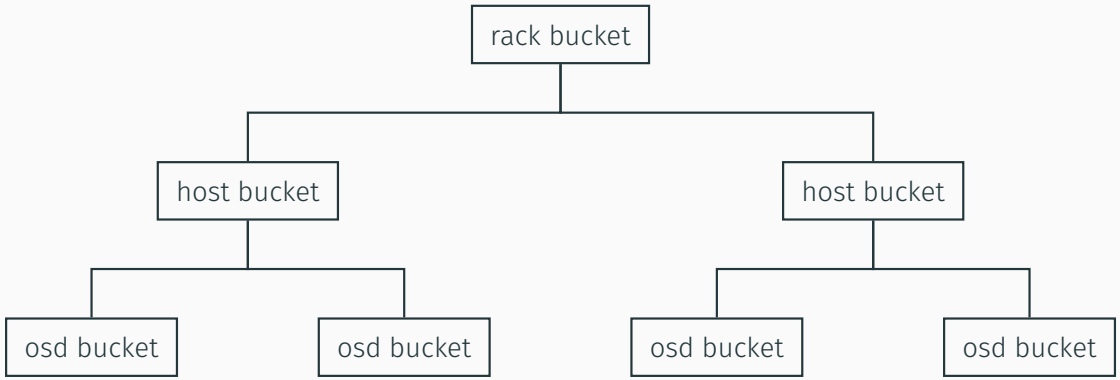


CEPH CLIENTS

LIBRADOS

- direct access to RADOS for applications
- C, C++, Python, Java, Erlang, PHP
- native socket access, no HTTP overhead

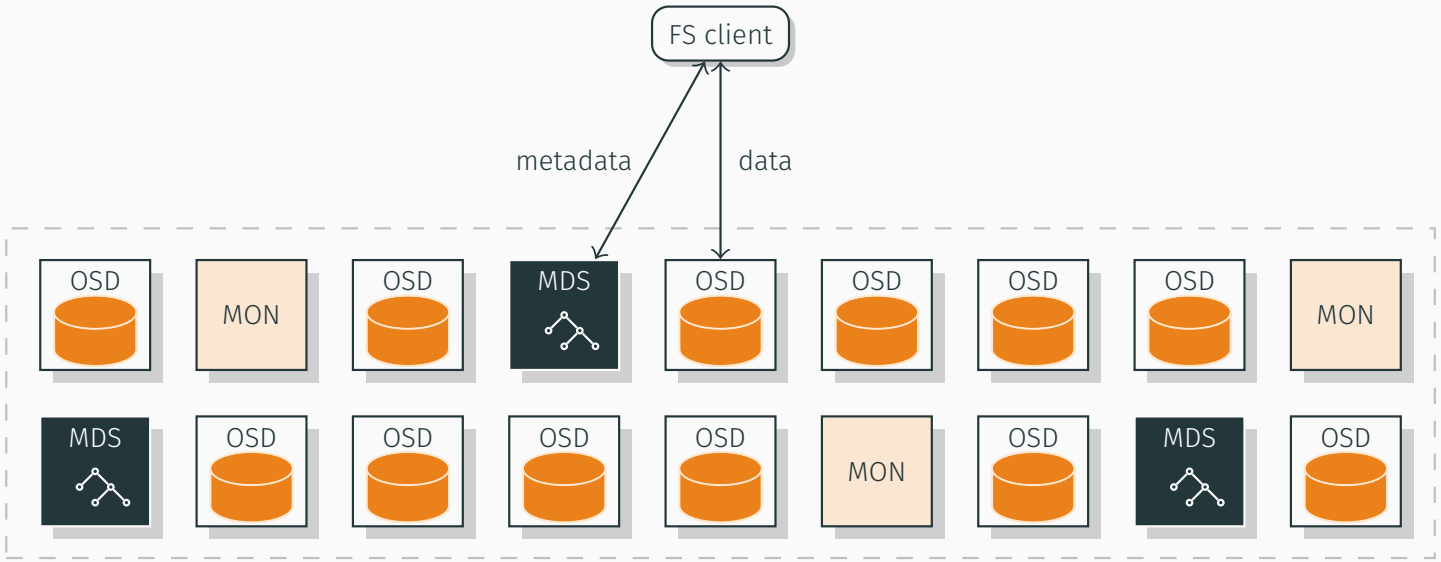
RADOSGW

- RESTful API
- unified object namespace
- S3 and Swift compatible
- user database and access control
- usage accounting, billing

RBD

- Storage of disk images in RADOS
- Images are striped across the cluster
- Decoupling of VMs from host
- Thin provisioning
  - physical storage only used once you begin writing
- Snaphots, copy-on-write clones
- Support in Qemu, KVM

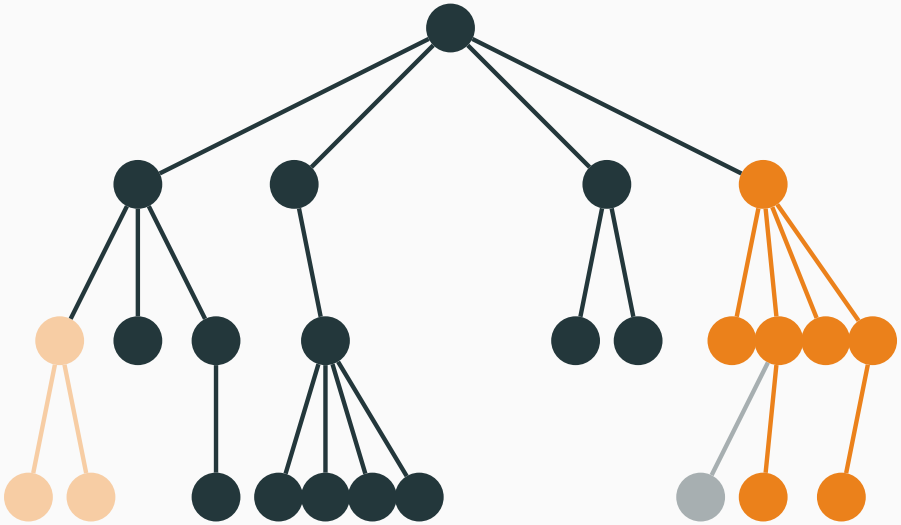
CephFS


FS client
metadata
data
OSD
MON
OSD
MDS
OSD
OSD
OSD
OSD
MON
MDS
OSD
OSD
OSD
OSD
MON
OSD
MDS
OSD

Metadata Server

- Manages metadata for POSIX-compliant filesystem
  - directory hierarchy
  - file metadata: owner, timestamps, mode etc
- Stores metadata in RADOS
- Multiple MDS for HA and load balancing

DYNAMIC SUBTREE PARTITIONING

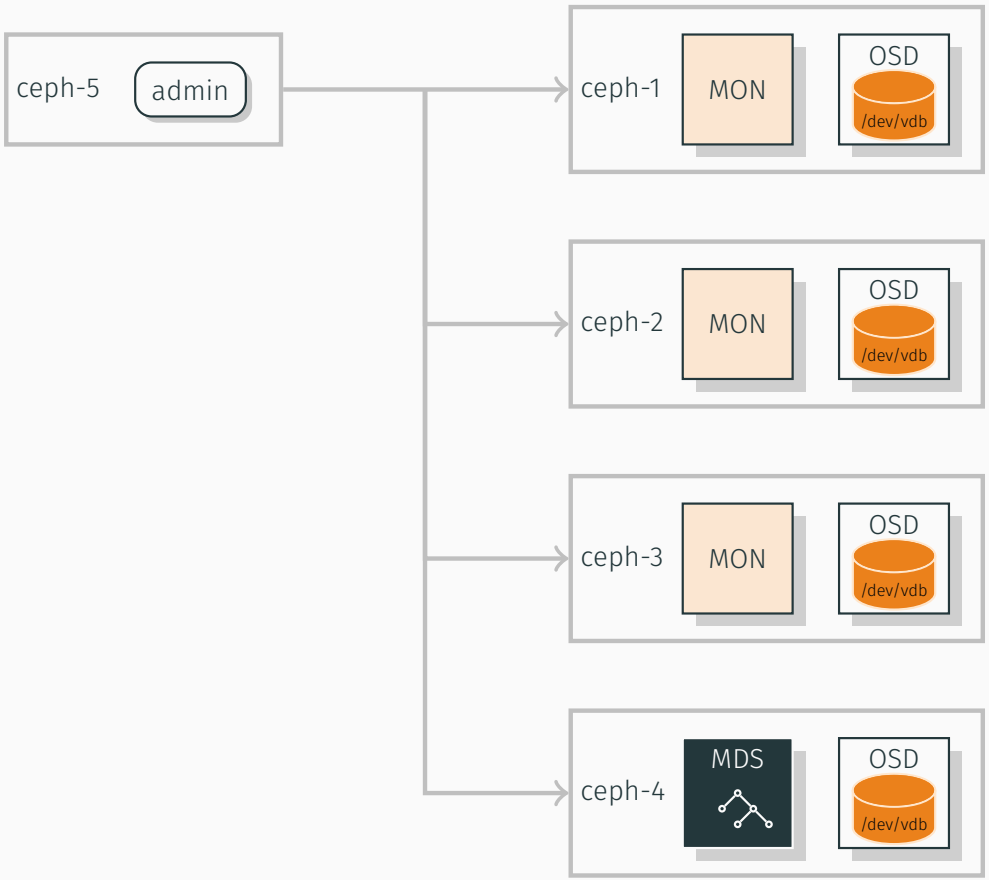


TUTORIAL

OVERVIEW

- Deploy a Ceph cluster
- Basic operations with the storage cluster
- Data placement: CRUSH
- Ceph Filesystem
- Block storage: RBD
- Advanced topics: erasure coding
- Troubleshooting challenge

CLUSTER SET-UP



Questions?