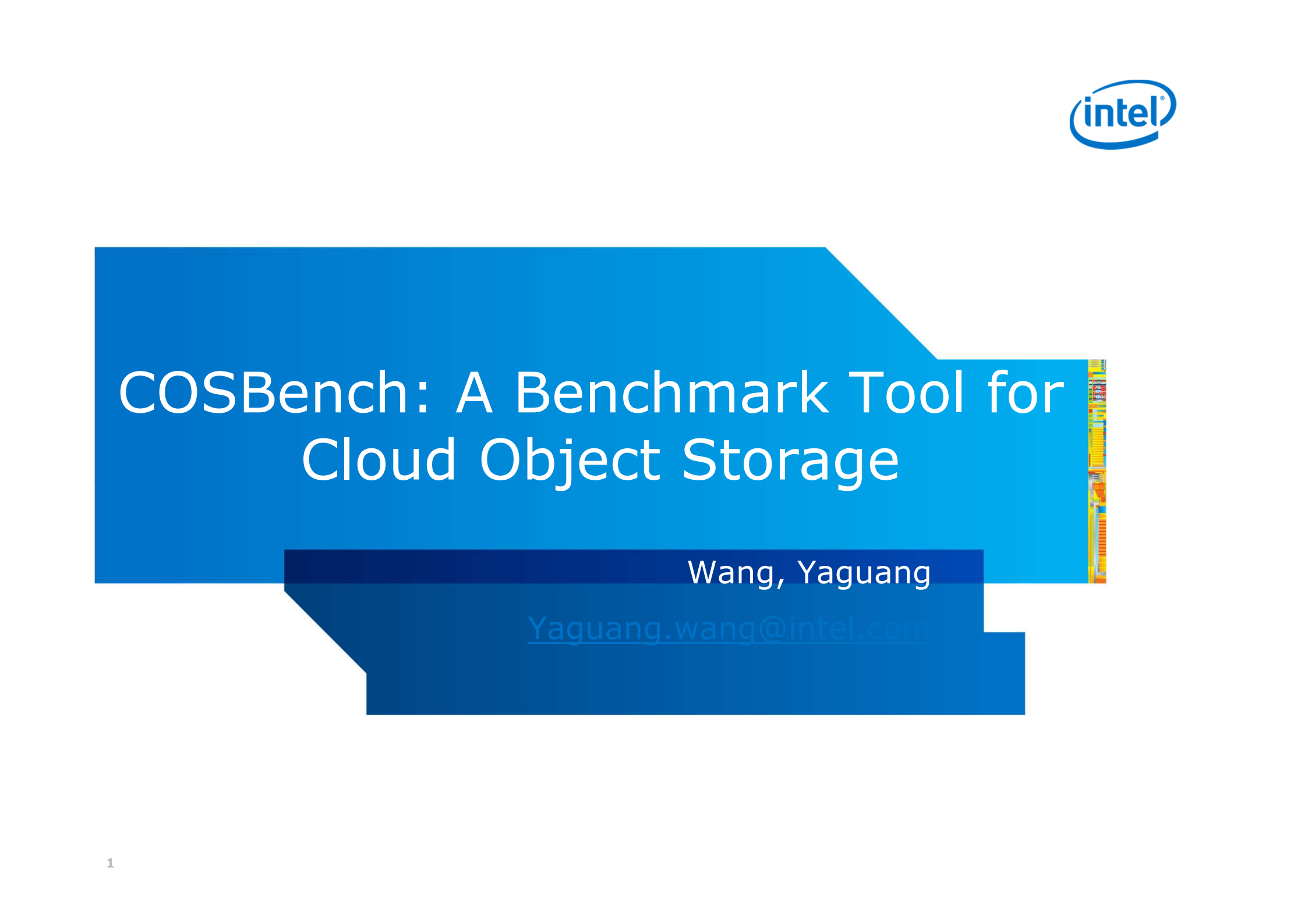

COSBench: A Benchmark Tool for Cloud Object Storage

Wang, Yaguang

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Agenda

- Storage towards Tomorrow's Data Centers
- Cloud Storage & COSBench Overveiw
- Case Study with COSBench
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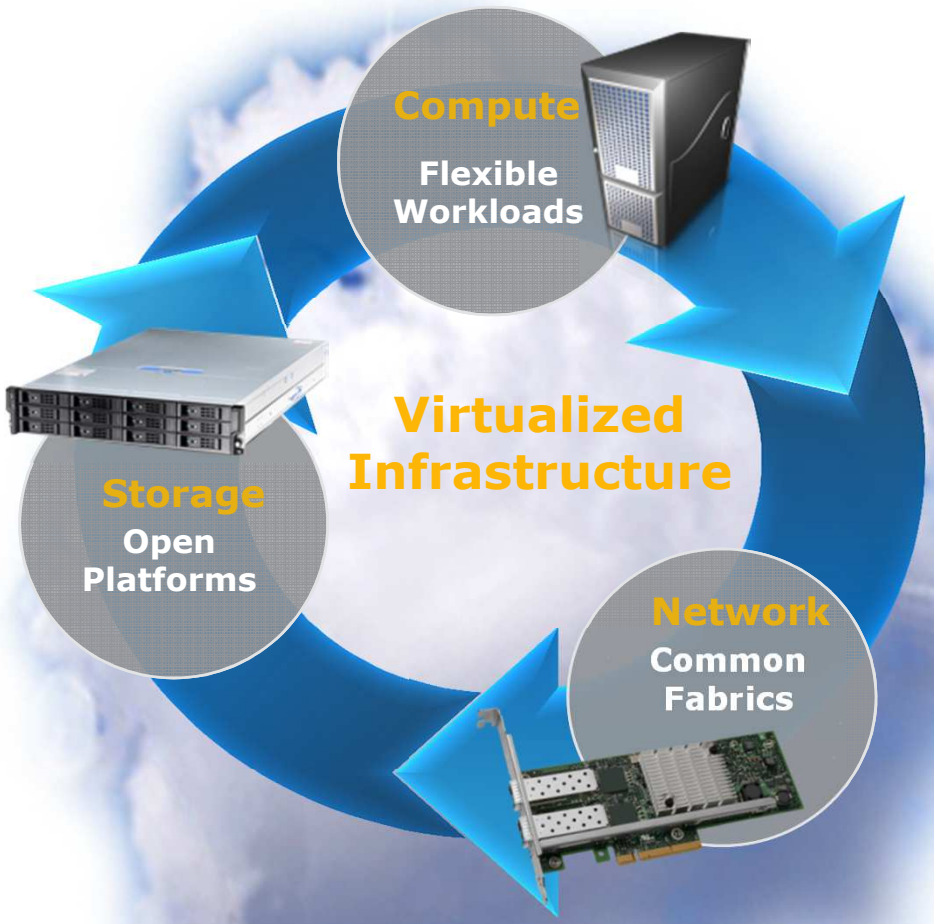
Data Centers are Evolving

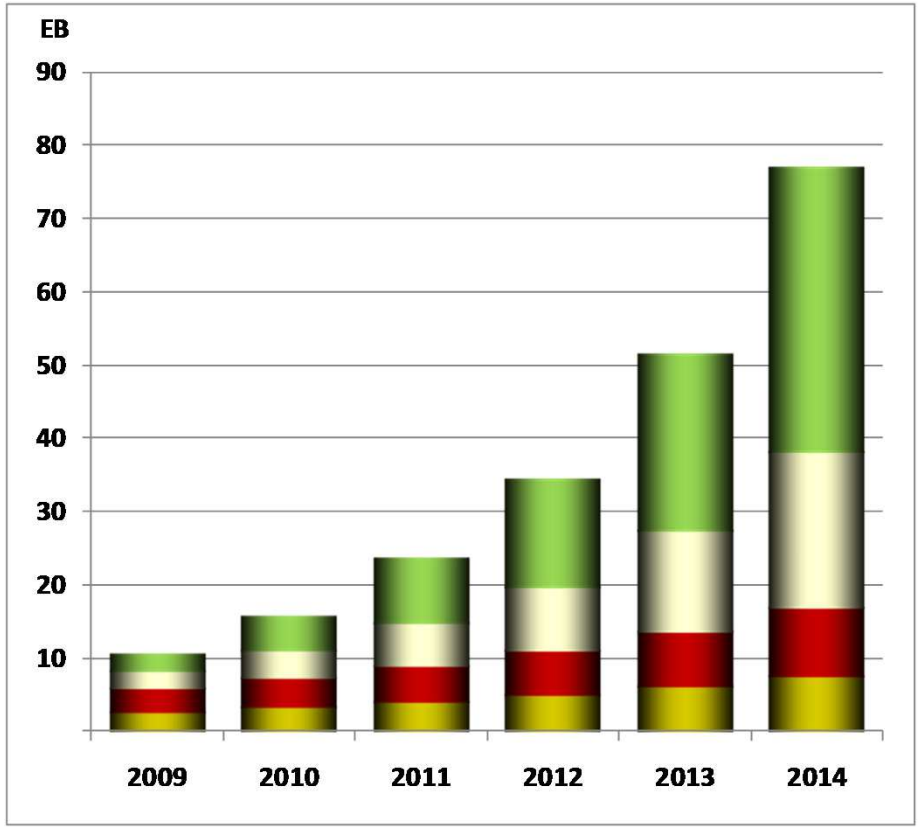


- **Data centers are built upon three fundamental pillars:**
  - **Compute**
  - **Storage**
  - **Networking**
- **All three are critical for efficient data center operations**
  - **Balanced in performance and utilization**

A Balanced Data Center is Essential for Efficiency

IDC Storage Capacity Growth†

- **Structured data (23.6% CAGR)**
  - Traditional enterprise database
- **Replicated data (24.2% CAGR)**
  - Backups
  - Data warehouses
- **Unstructured data (54.8% CAGR)**
  - Archives
- **Content Depots (75.6% CAGR)**
  - Web
  - Email
  - Document sharing
  - Social network content (pictures/videos)



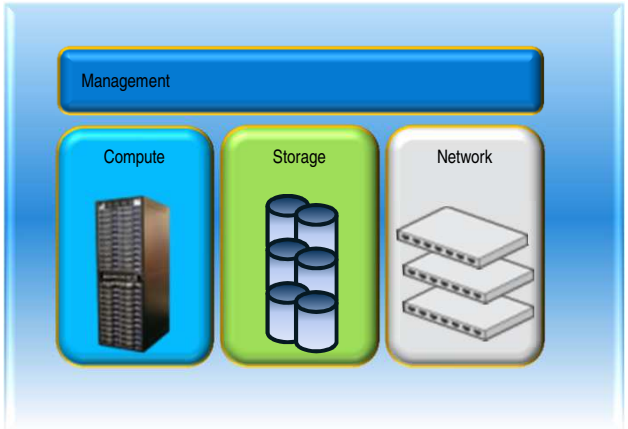
2012 Deployment Estimate: ***~7.6 million drives ~500,000 storage systems‡***

†Source: IDC, Worldwide Enterprise Storage Systems 2010–2014 Forecast: Recovery, Efficiency, and Digitization Shaping Customer Requirements for Storage Systems, Doc

‡Source: Internal estimates based on the IDC Worldwide Enterprise Storage Systems Forecast # 223234., May 2011

Intelligent Enterprise Storage is More Important than Ever

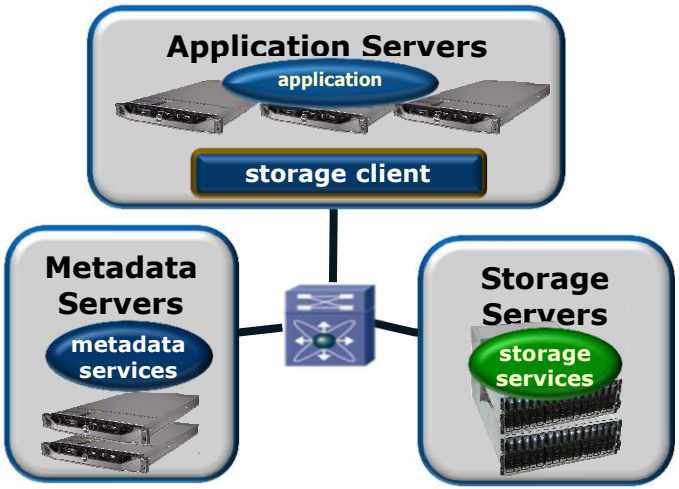
Traditional Storage



Does not scale smoothly with the rapid growth of distributed cloud storage capacity and performance needs

- **Designed for structured data**
- **Restricted to single site**
- **Vertically integrated storage with separate storage network**

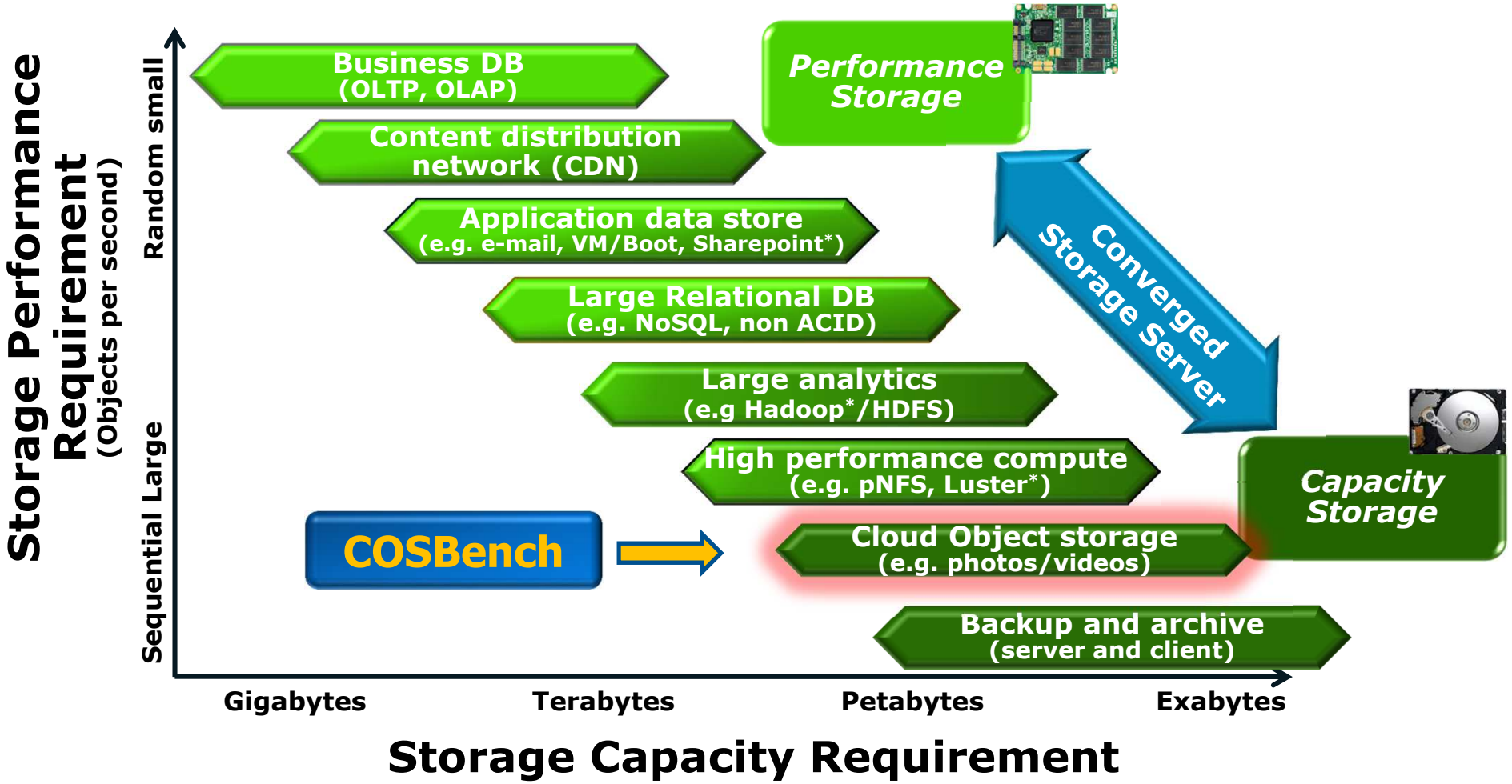
Scale Out Storage



- **Built on standard server and storage hardware and software components.**
- **Enables application-specific storage tuning for energy efficient performance.**

Scale-out storage is the foundation for tomorrow's data centers

Storage Solution Usage Models



Key Storage Usage Models Have Differing Requirements Thus Need New Benchmarks

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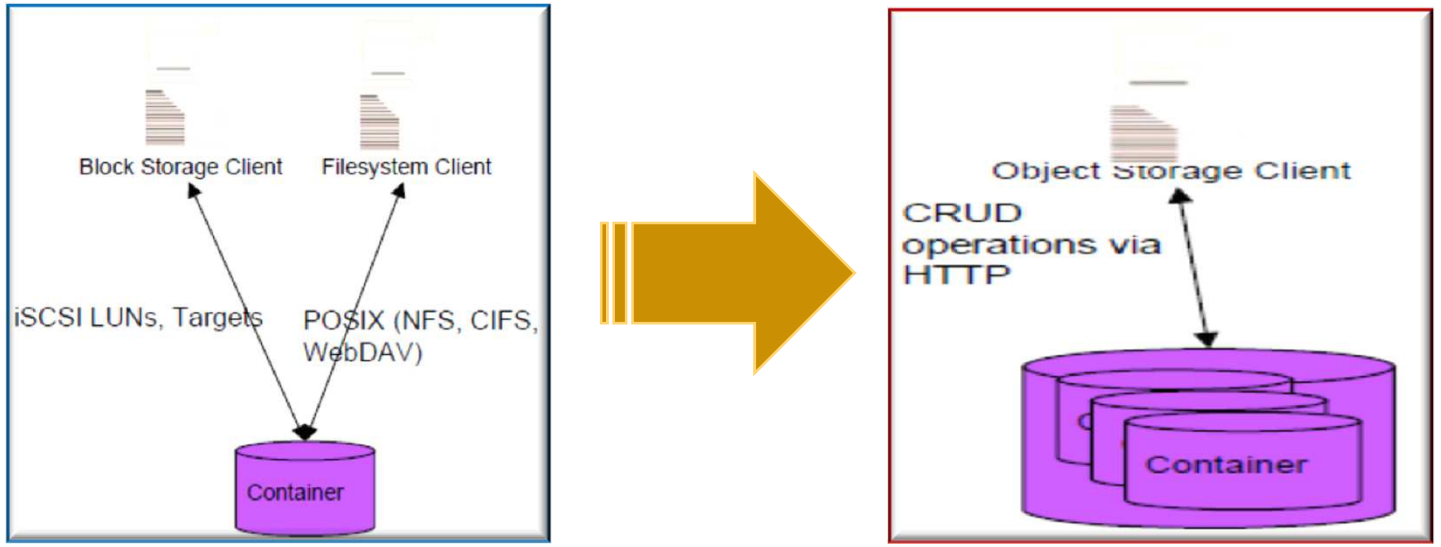
Cloud Object Storage Overview

Amazon's S3 cloud storage service hits 1 trillion files

Can cloud storage scale? You bet. Amazon's Jeff Barr notes this morning that its S3 online storage has blown past one trillion objects.

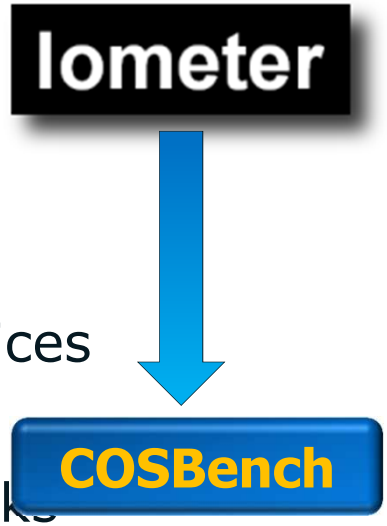
- **Cloud (object) storage** is a model of networked online storage where data is stored in virtualized pools of storage . (from wikipedia)



The rising of cloud storage demands new benchmark tool.

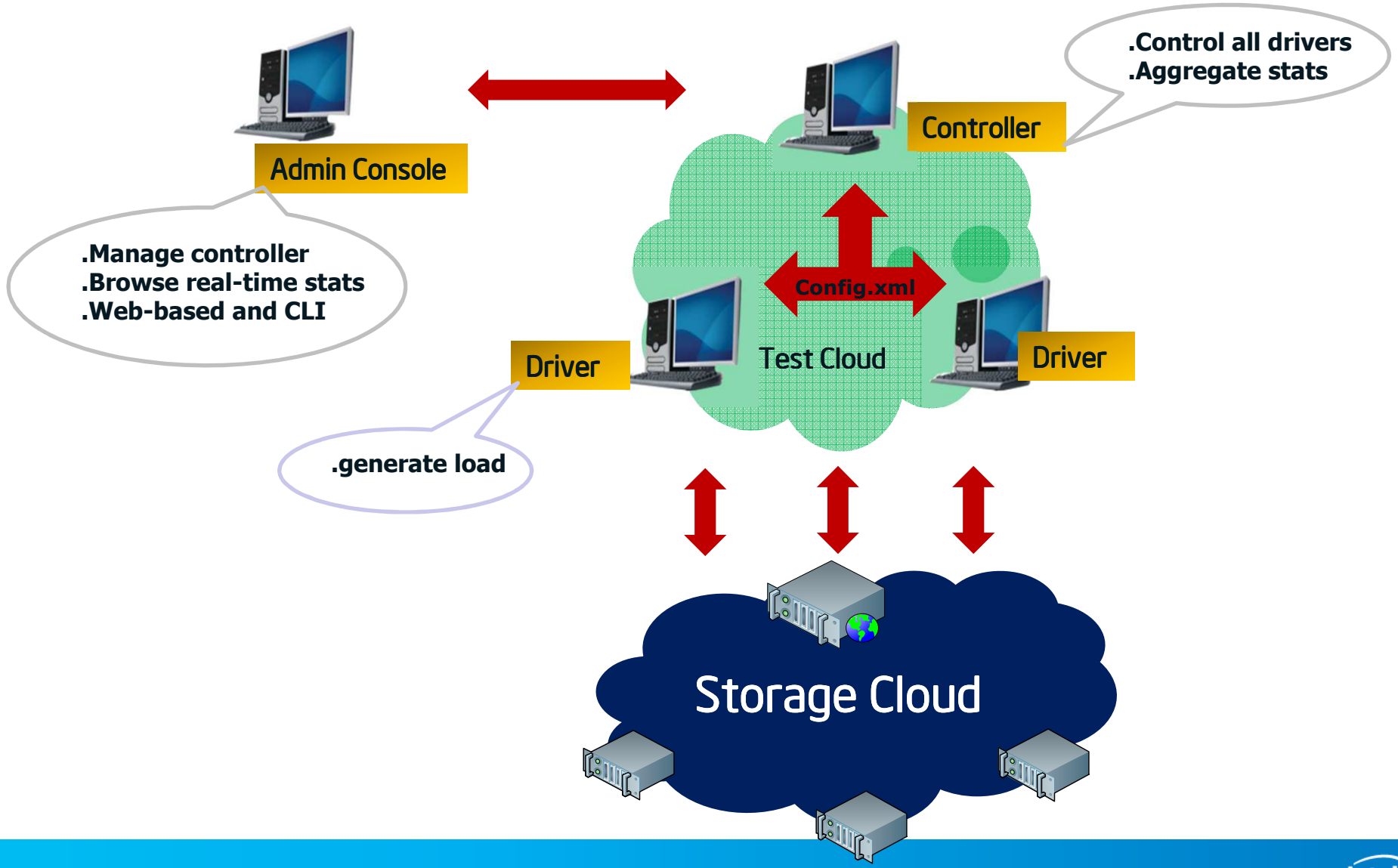
COSBench Introduction

- An benchmark tool to measure Cloud Object Storage performance provided by Intel, supports
  - openstack swift/ amplidata amplistor,
  - in the future, Amazon S3, Google and Microsoft's …
- Benefit:
  - For Cloud user,
    - Compare public Cloud Object Storage services
  - For Cloud builder,
    - Evaluate different Hardware/Software Stacks
    - Identify bottleneck and make optimization

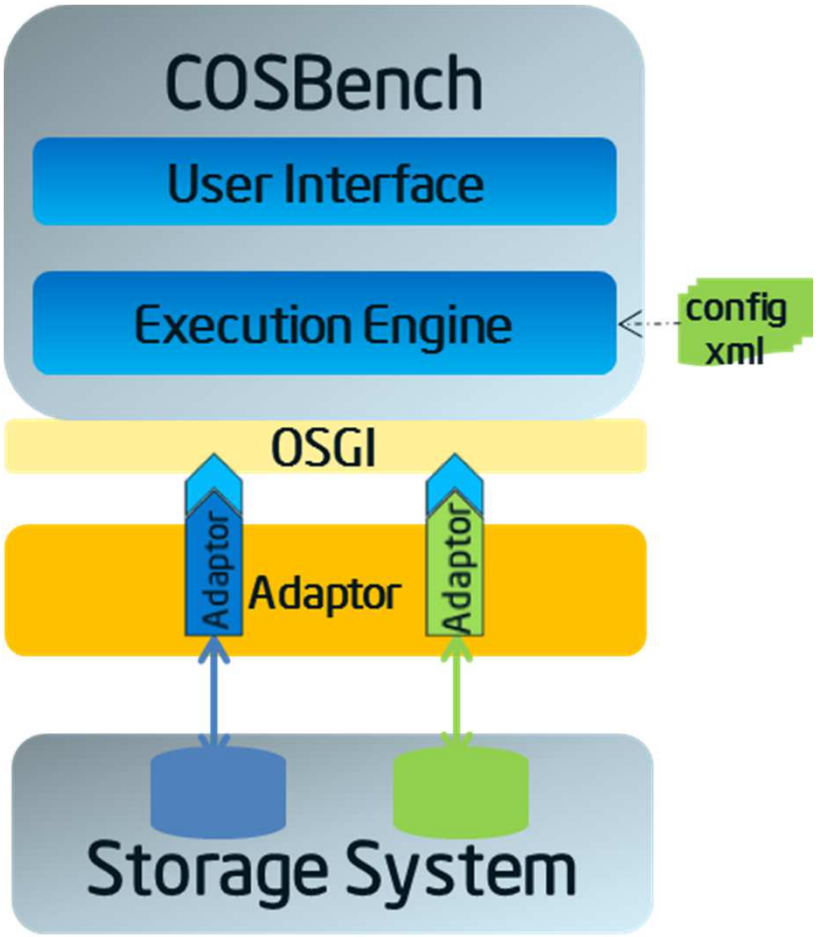


COSBench is open sourced with Apache V2 License, it can be accessed on github: https://github.com/intel-cloud/cosbench. We are keeping improving it and welcome for contributions from you!

Key Components



Major Features

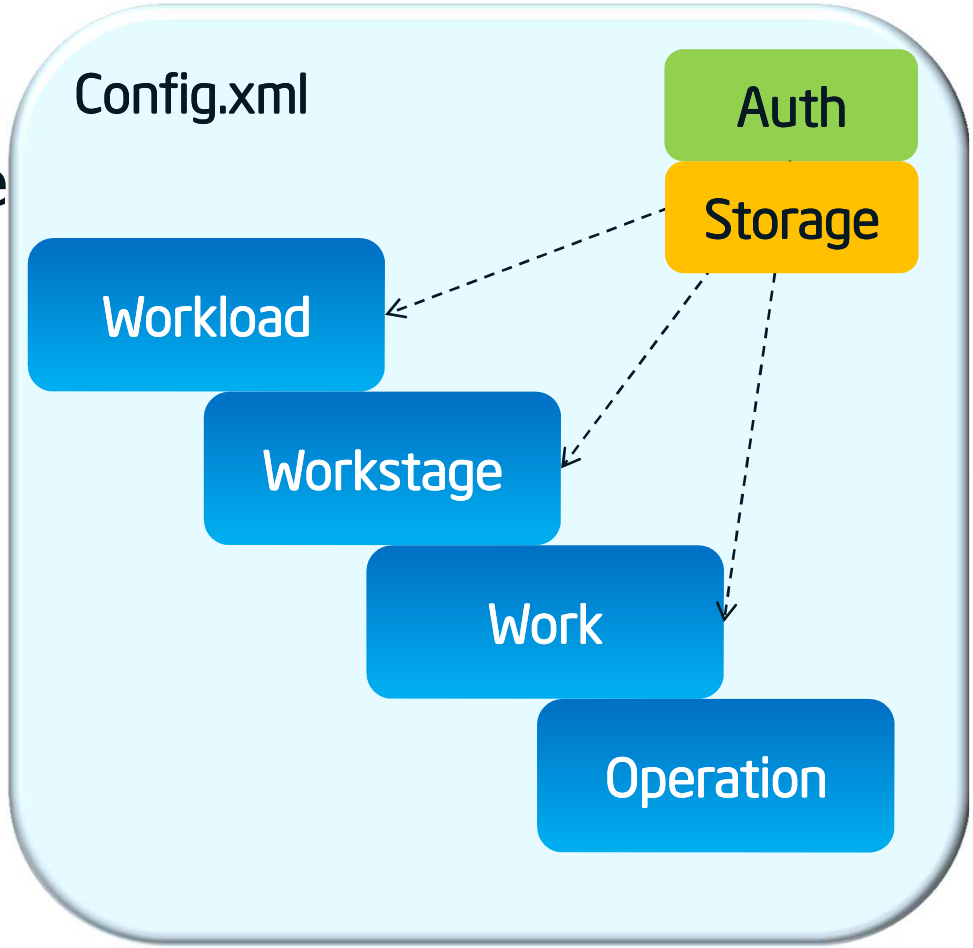


- **Cross Platform Deployment:**
  - ***Ubuntu 12.04 LTS /RedHat Enterprise Linux 6.1/Windows 7.***
- **Distributed load testing framework.**
- **Pluggable adaptors:**
  - ***OpenStack* Swift/Amplidata* Amplistor/Amazon* S3/Ceph***
  - ***SNIA* CDMI (upcoming)***
- **Web-based real-time performance monitoring**
- **Rich performance metric reporting**
  - ***Performance timeline***
  - ***Response time histogram***
- **Flexible workload definition**
- **Open Source (Apache License)**

Workload Configuration

- Execution of workstage is sequential, while execution of work in the same workstage is in parallel.

- "config" attribute is for variable parameters.



Workload Configuration

```
- <workflow>
  - <workstage name="init">
      <work type="init" workers="8" config="containers=r(1,32)" />
    </workstage>
  - <workstage name="prepare">
      <work type="prepare" workers="8" config="containers=r(1,32);objects=r(1,50);sizes=c(64)KB" />
    </workstage>
  - <workstage name="main">
    - <work name="main" workers="8" rampup="100" runtime="300">
        <operation type="read" ratio="80" config="containers=u(1,32);objects=u(1,50)" />
        <operation type="write" ratio="20" config="containers=u(1,32);objects=u(51,100);sizes=c(64)KB" />
      </work>
    </workstage>
  - <workstage name="cleanup">
      <work type="cleanup" workers="8" config="containers=r(1,32);objects=r(1,50)" />
    </workstage>
  - <workstage name="dispose">
      <work type="dispose" workers="8" config="containers=r(1,32)" />
    </workstage>
  </workflow>
</workload>
```

Flexible load control

object size distribution

Read/Write Operations

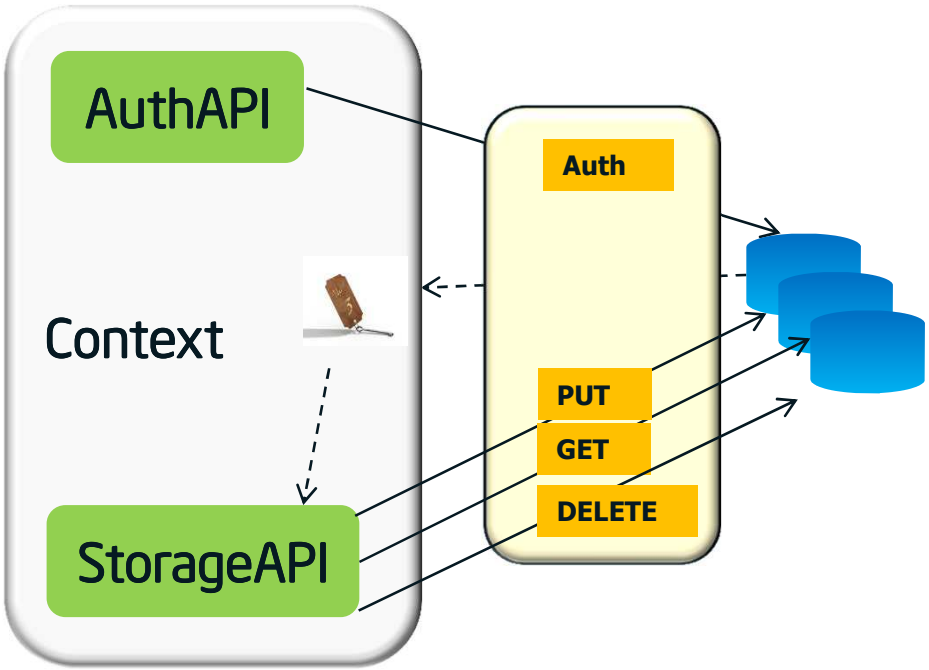
Workflow for complex stages

Flexible configuration parameters is capable of complex Cases

Extensible framework

Separate auth and storage API, so

- One auth → multiple storages
- One storage → multiple auths



Extensible framework supports new object storage services.

Performance Metrics

General Report

Op-Type	Op-Count	Byte-Count	Avg-ResTime	Throughput	Bandwidth	Succ-Ratio
read	12.58 kops	12.28 MiB	10.14 ms	628.84 op/s	628.84 KiB/S	100%
write	3.21 kops	200.88 MiB	10.09 ms	160.71 op/s	10.04 MiB/S	100%

Throughput (Operations/s): the operations completed in one second

Response Time (in ms): the duration between operation initiation and completion.

Bandwidth (KB/s): the total data in KiB transferred in one second

Success Ratio (%): the ratio of successful operations

Performance Metrics/Reporting/Chart

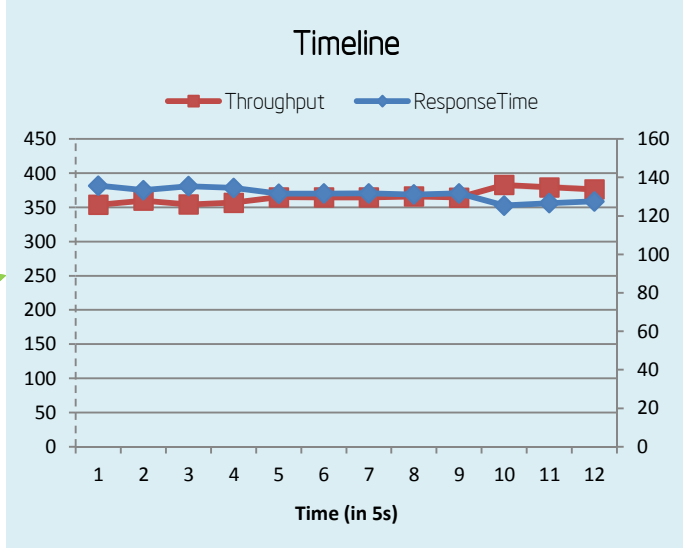
Id	Op	Sp	SC	BC	RT	T	BW	Succ
w138-s1-1	write	write	20.00	21,474	24,839	0.16	172	100%

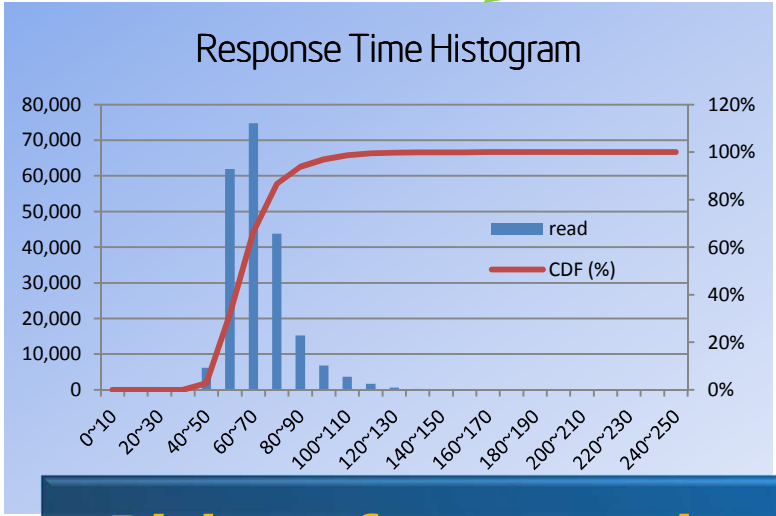
summary

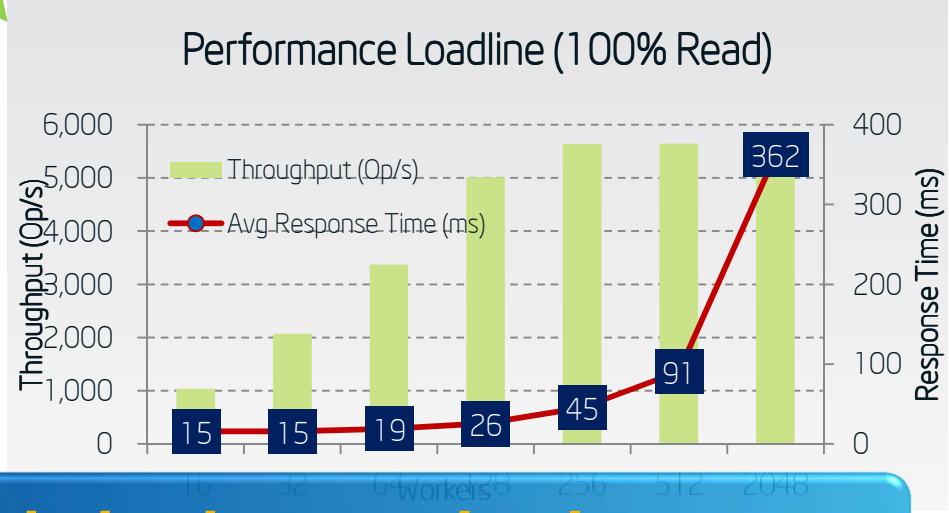
timeline

histogram

loadline

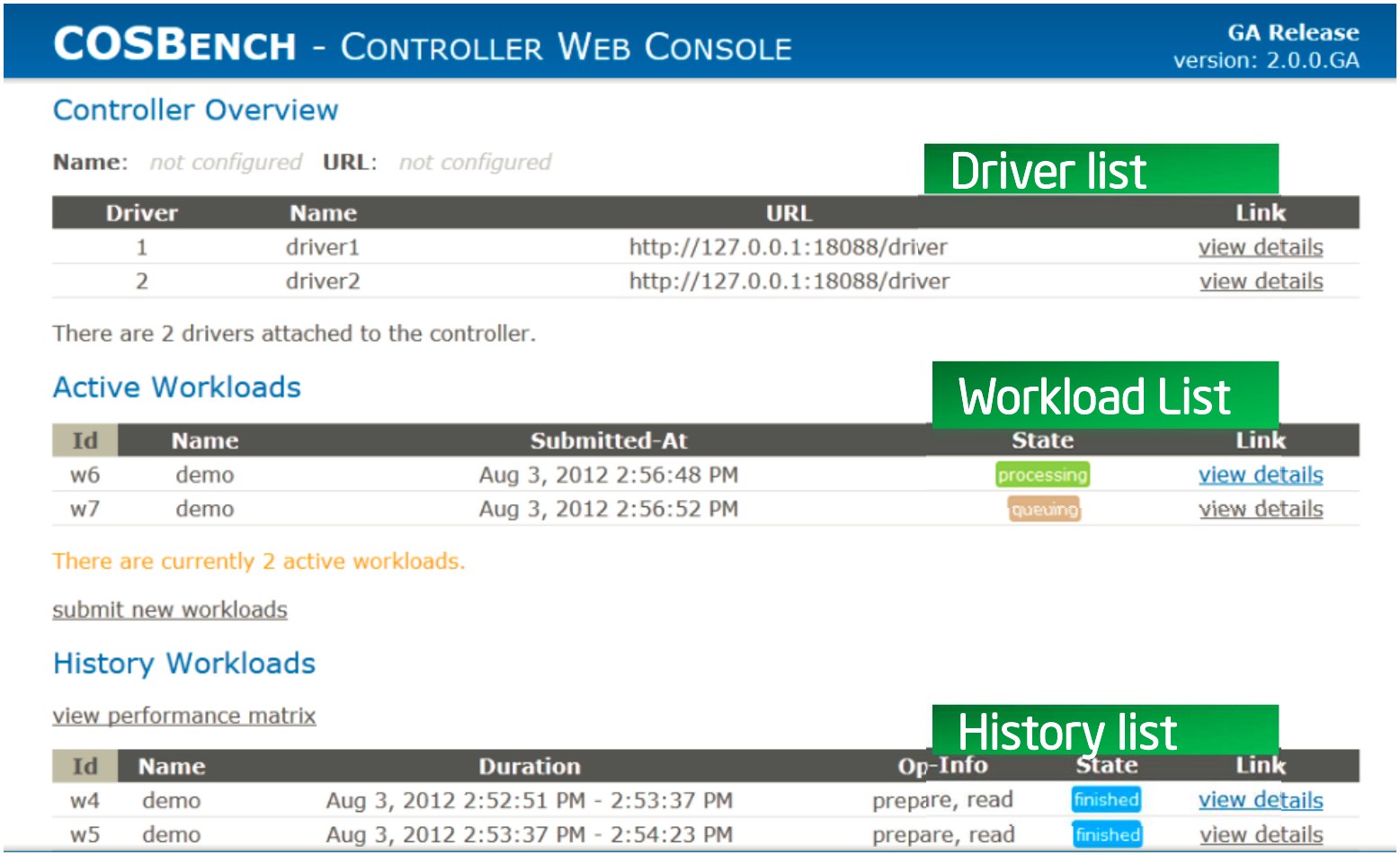






Rich performance data to help characterization.

Web Console



Intuitive web UI to give overview.

Live Demo

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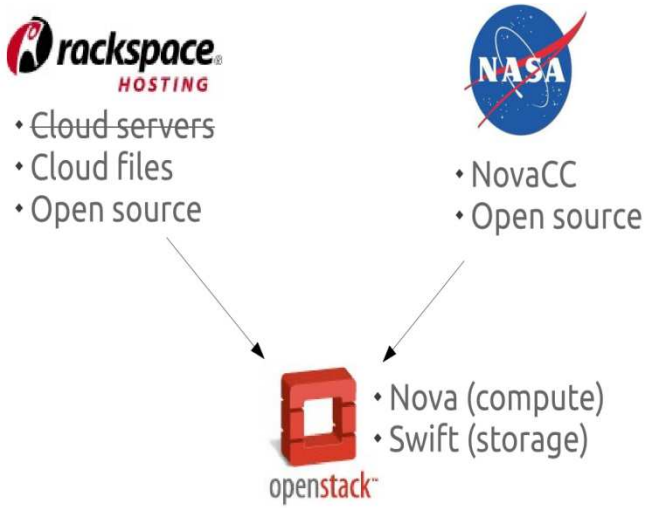
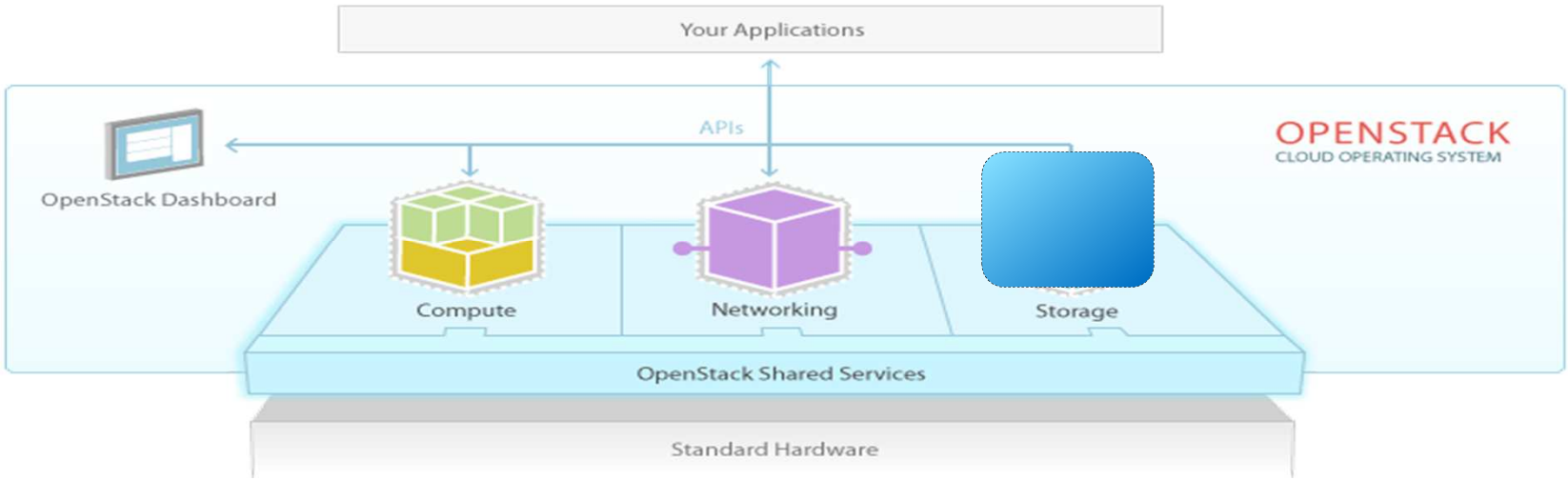
OpenStack* Swift overview

- OpenStack* is open source software to build private and public clouds.
- OpenStack Object Store (Swift): Create petabytes of reliable storage using standard servers



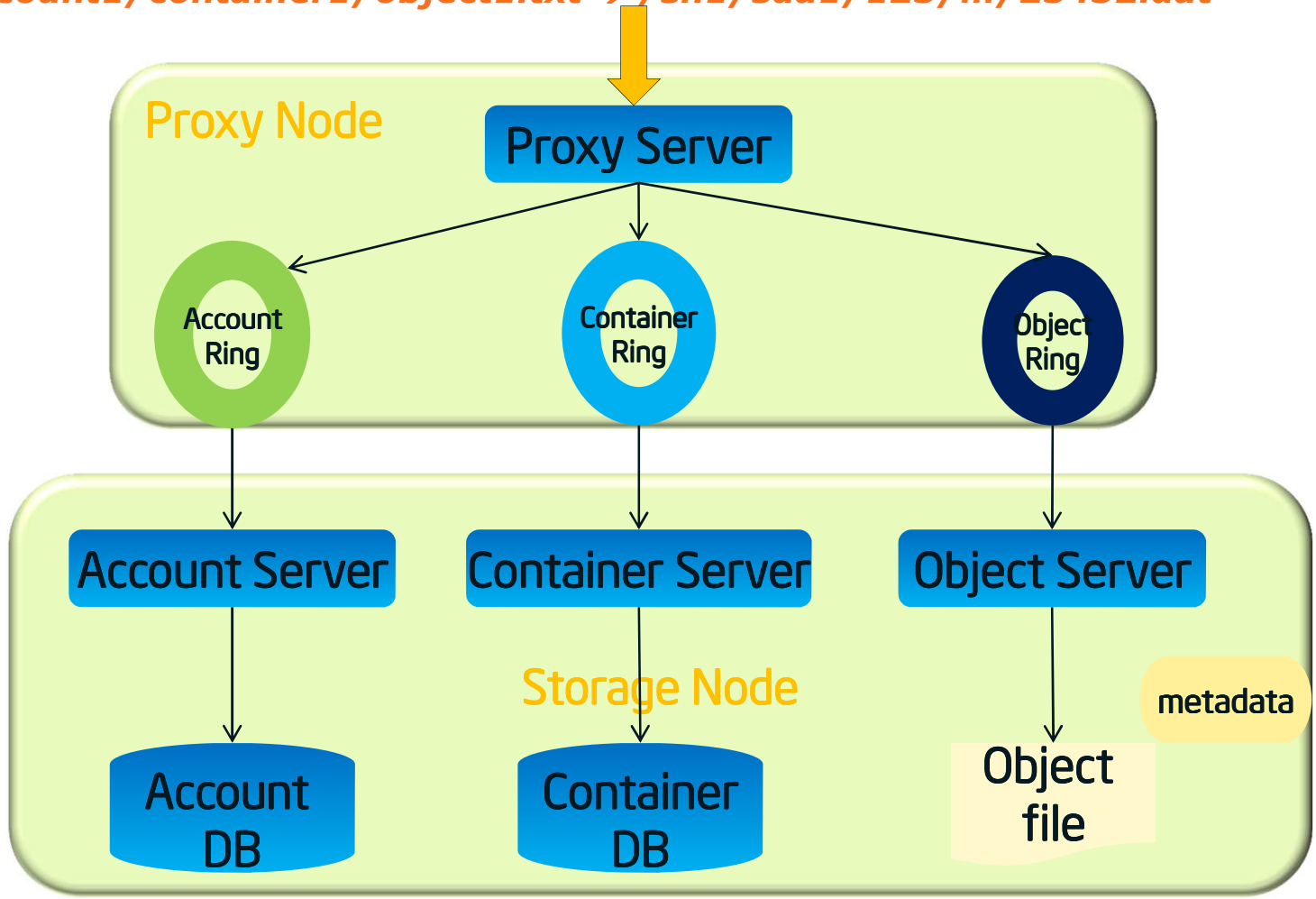


†Source: docs.openstack.org

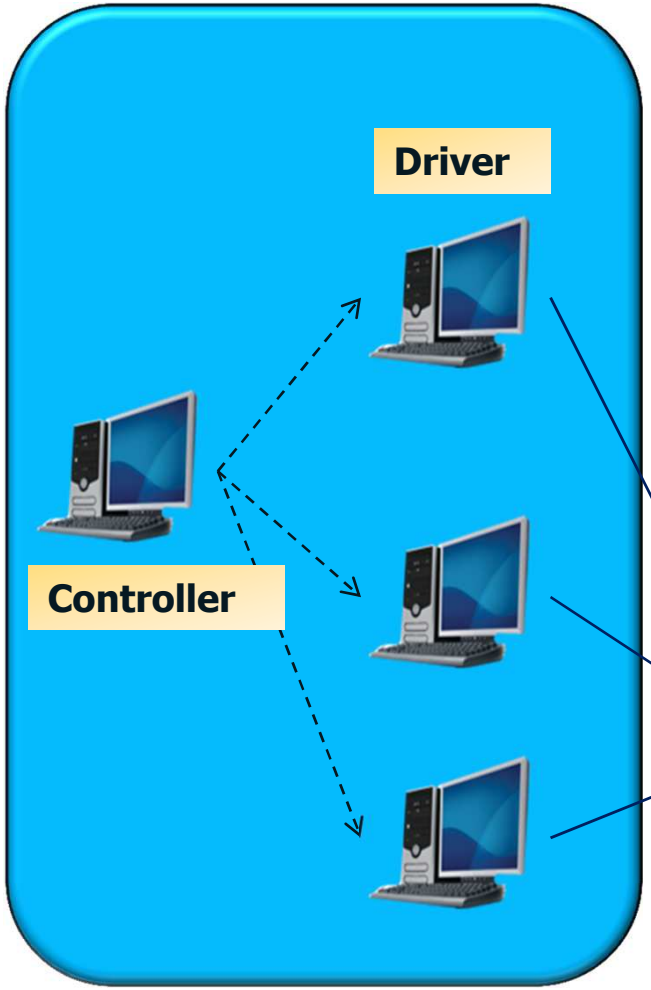
OpenStack* Swift Overview

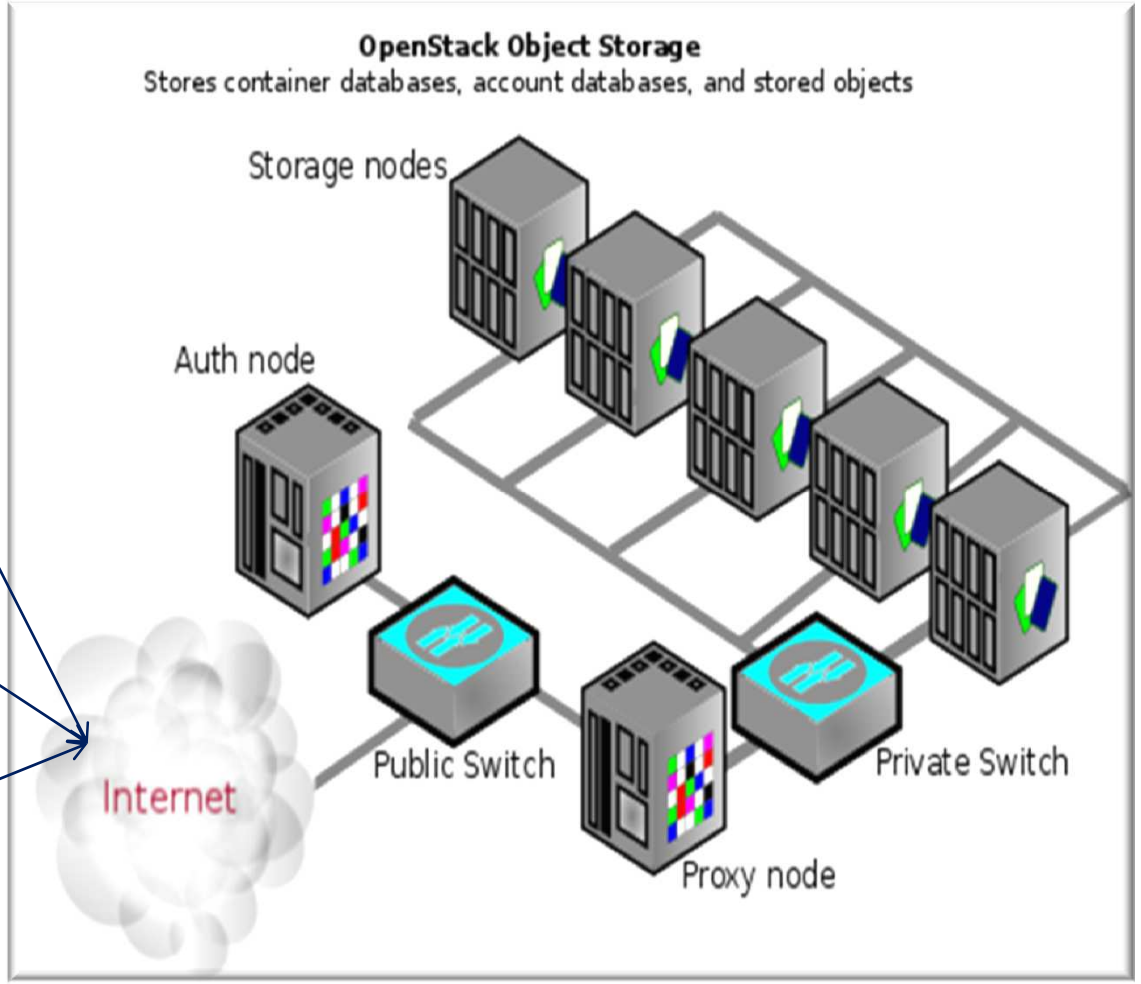
Entities ← RING → physical location (zone/device/partition/…),

e.g.: /account1/container1/object1.txt → /sn1/sda1/123/…/23432.dat



Test OpenStack Swift performance





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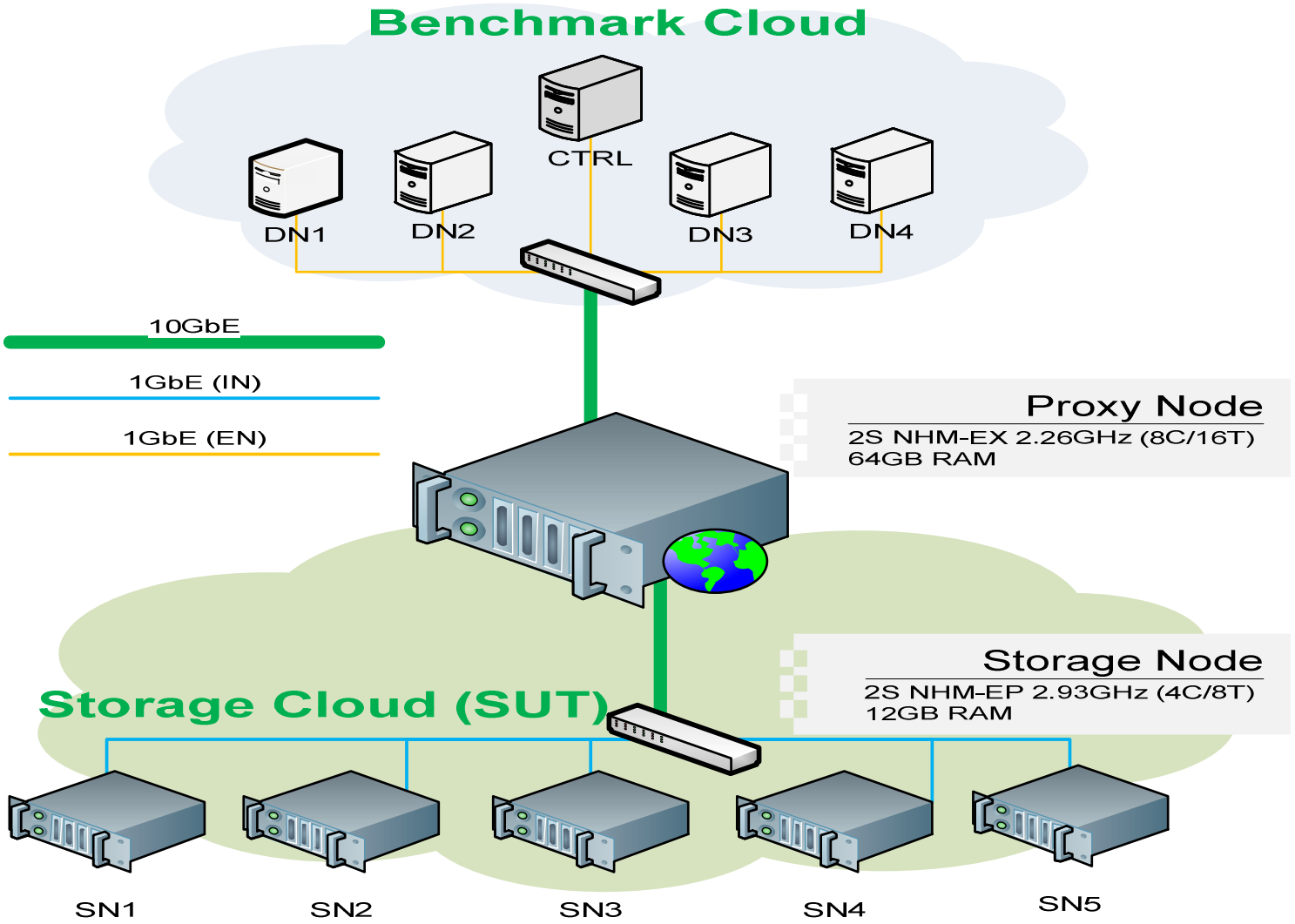

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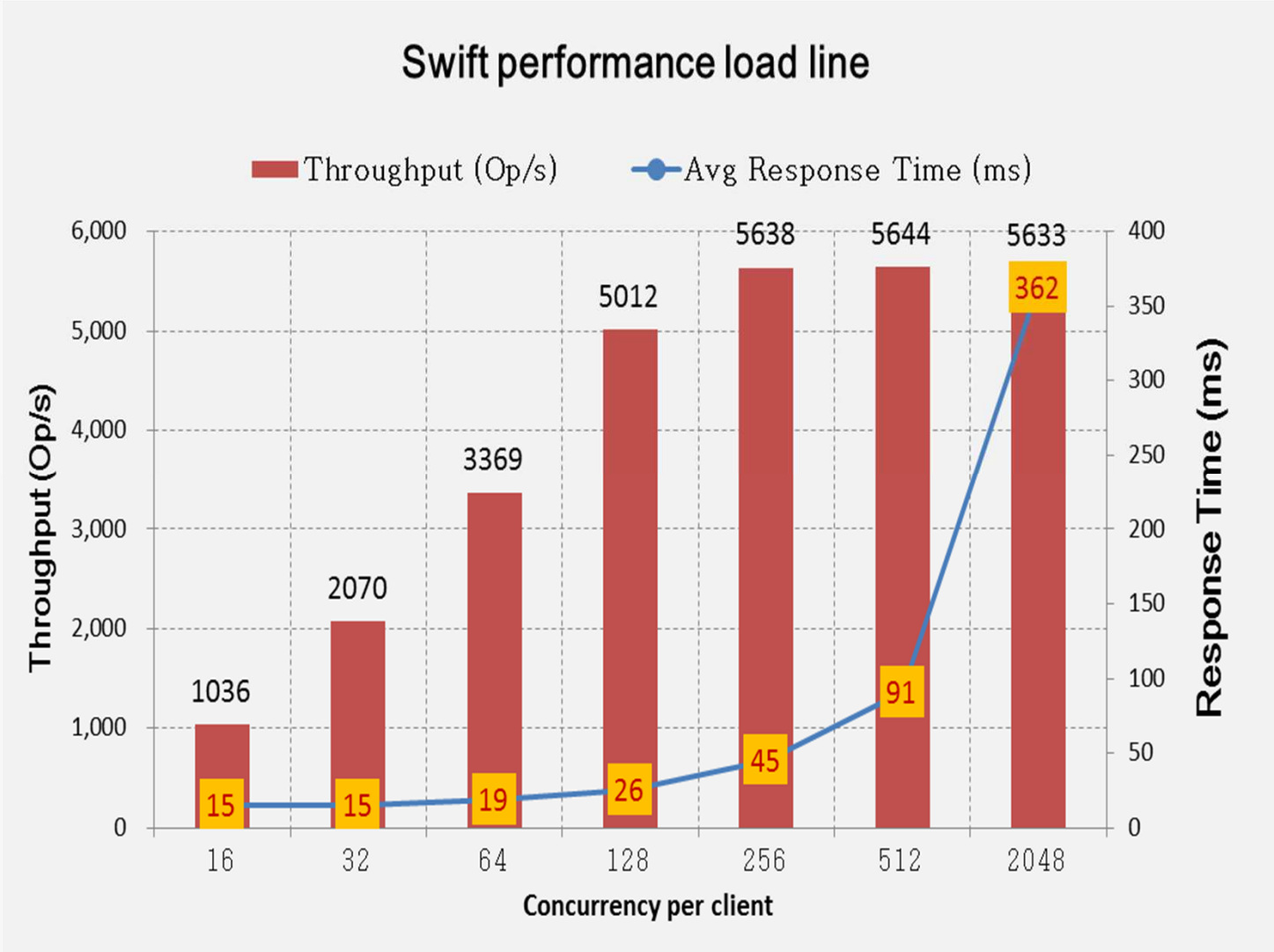

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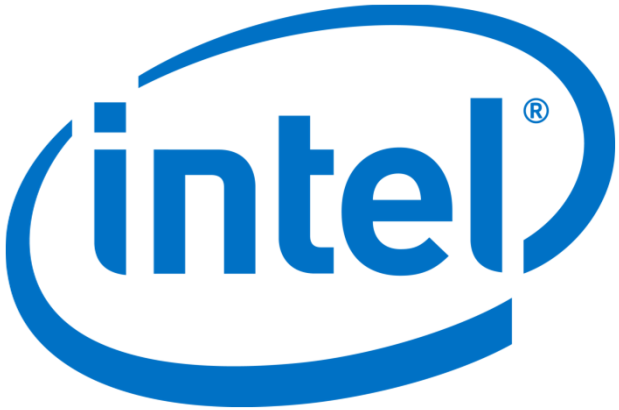
Summary

- New storage Usage model rises for Cloud Computing age, which need new benchmark
- COSBench is a new benchmark developed by Intel to measure Cloud Object Storage service performance
- COSBench is useful to analyze Cloud Object Service system performance, identify bottleneck and conduct optimization


intel