CRITIQUE - 11 [Lecture - 13 Converging compute and Storage in Cloud]

The main topic of today's lecture was Converging compute and Storage in the cloud. We discussed what is cloud computing, history of cloud computing and a brief overview of the virtualization technology. We also talked about cloud storage architecture. Later part of the lecture included topics like storage resource management, an overview of storage architecture and how to build a new kind of storage service.

The lecture started with, how the word "cloud computing" is an overused buzzword. Cloud computing represents a huge paradigm shift in the way backend software services are delivered. Cloud computing enabled on-demand network access to shared resources like network, storage, server, applications etc. The discussion on the historical view of the cloud computing was interesting and gave us an idea of how the cloud computing evolved over the years. I learned that the internet, commodity computing, and virtualization are the key ingredients for cloud computing. Virtualization (hypervisor) decouples the software from hardware and abstracts the physical resources of the machine. Virtualization can be done in software or hardware level. Some of the popular hypervisors are Qemu, KVM, VirtualBox, Hyper-V etc. Though virtualization offers a multitude of advantages, there are some limitations like hardware virtualization is expensive - OS is not designed to share hardware resources and limits tenancy, elasticity and performance.

The alternative to hardware virtualization is to virtualize operating system. In Linux, OS virtualization was done through changing the root directory (chroot). Chroot allows us to create multiple isolated instances of the host OS. FreeBSD extended chroot with security called jails. Sun came up with full OS virtualization called Zones. In the recent years more and more people, organizations etc have started using a variant of OS virtualization called "Containers" like Docker. Containers wrap all the system runtime libraries, code, tools etc as a complete filesystem [2].

We also looked at some of the companies which are into cloud computing like Amazon web services, Google, Microsoft, Joyent etc which offers infrastructure as a service (IaaS). IaaS is a form of cloud computing that provides virtualized resources over the internet. SaaS exposes software as a service hosted in the cloud like Gmail. PaaS (platform as a service) expands SaaS model by not only delivering the software but also exposing software for development like databases, os, web servers etc [3]. Cloud computing has become the de-facto way of deploying software / service for startup companies. Cloud provides benefits like dynamic scalability, faster provisioning, improved efficiency and reduced cost.

AWS shared storage is called elastic block storage (EBS), which is distributed and replicated. EBS storages data as blocks whereas S3 stores them as objects. We discussed how to manage storage resources and Disk IO scheduling in case of spinning disks so that the consumers gets a fair share of disk access time.

We discussed how to control a fair share of IOPS in the cloud computing systems. The IO throttling is done by counting the number of reads and writes per zone over last 2-second cycle. By averaging the number of IO per zone we can determine which zone is over- or under-consuming the IO. One thing to notice here is that only disk IO's are throttled and ARC operations are unimpeded. The storage architecture also plays a role in IO's. There are two different ways to set up cloud storage - shared storage and local storage. In shared storage, a bunch of compute engines shares a storage over a network like AWS EC2 whereas in local storage each compute engine has its own storage. The discussion on pros and cons of this two storage architecture was informative and gave me an idea when to use which architecture. We also briefly reviewed some of the courteous, discourteous, less common and real world storage failures.

Last part of the presentation was about the Joyent internal storage architecture which uses local storage. Manta storage service is a scalable, distributed object storage service with integrated compute engine. A bit of history about how manta evolved and the unix concepts that were borrowed to build manta was interesting. Manta supports big data concepts like map reduce, piping the output etc. The discussion of CAP theorem was totally new concept to me, it was well presented and straightforward to understand. Overall, the lecture was excellent. I learned a lot about cloud computing, cloud storage architecture, containers, hypervisors, IO throttling etc.

Reference:
1. Converging compute and Storage in cloud - Lecture slides by Jerry Jelinek.
2. https://en.wikipedia.org/wiki/Docker_(software)
3. http://www.stratoscale.com/blog/cloud/iaas-paas-saas-caas/