

**CS528**

# **Cloud System Economic Model**

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# Economic: Cloud Computing

- **Lower computer costs**
- To run cloud computing's web-based applications
  - You do not need a high-powered and high-priced computer
- Since applications run in the cloud, not on the PC
  - Your PC does not need high processing power or hard disk space demanded by traditional desktop software.
- When you are using web-based applications
  - Your PC can be less expensive, with a smaller hard disk, less memory, more energy efficient processor
  - PC does not even need a CD/DVD drive,
  - No software programs have to be loaded
  - No document files need to be saved.

# Economics: Cloud Computing

- **Instant software updates**
- You are no longer faced with choosing between obsolete software and high upgrade costs.
- When the application is web-based
  - Updates happen automatically
  - Available the next time you log into the cloud.
- When you access a web-based application
  - You get the latest version
  - Without needing to pay for or download an upgrade.

# Economics: Utility Model

- Do we require to own a car to ride?
- Rent a CAR for 1 month (schedule your self how you will use)
- Rent a CAR for 1 Day (schedule your self how you will use)
- Use Pickup or Drop service, personalized
  - Src-Dst defined
- Use shared services: Piggy back with others

# OLA/UBER Economic Model

- OLA/UBER maintain website and logistics
- Car Driver need to register to OLA/UBER
- Without registering to OLA/UBER
  - 2 to 3 trip request per day, Benefit is less, he need to charge more : Rs 600/ to airport trip
- With OLA/UBER Car driver
  - 10-30 trip per day, car utilization is higher
  - Benefit is higher, can afford to give at cheaper price

# OLA/UBER Economic Model

- Profit win-win for all:
  - To users (cheaper), no need to keep the car for whole day
  - drivers (more request and get higher profit)
  - OLA/UBER provider (charge money to driver without actually doing the work)

# CAR Rental Economic Model

- CAPEX : Cost of the CAR
  - 3-5 lakhs for Small Cars
  - 5-12 lakhs for mid-size Cars
- OPEX : Operational Cost
  - Petrol/Diesel Cost
  - Higher Mileage: Profit is higher, Diesel engine mileage is higher
  - AMC Service cost, Repairing cost
- Once you purchase a CARs, try to reduce the OPEX
  - How to increase Mileage or reduce Fuel cost

# Efficient Economic Model

- A Guy spend CAPEX : Spend 10 Lakhs on purchasing a new CAR
  - Got his status elevated, proud owner of CAR
- OPEX : Operational Cost
  - Petrol/Diesel Cost : Rs 5/KM
  - Service (10K) and Insurance (10K), paid extra 20K per Annum for Parking
- He drove for 7 year, 30,000 Km and sold the same car for 3 lakhs
  - OPEX for 7 Years:  $30K * 5 + 40K * 7 = \text{Rs } 4.30\text{L}$
- **Cost per KM:  $(10\text{L} + 4.3\text{L} - 3\text{L}) / 30\text{K} = \text{Rs } 37.8/\text{KM}$**
- **He takes 7L loans to purchase the car: Rs 46.5/KM**



# Efficient Economic Model

- A Guy spend CAPEX : Spend **3 Lakhs on purchasing a 2<sup>nd</sup> hand CAR**
  - **Got his status elevated, proud owner of second hand CAR**
- OPEX : Operational Cost
  - Petrol/Diesel Cost : Rs 5/KM
  - Service (10K) and Insurance (10K), paid extra 20K per Annum for Parking
- He drove for 5 year, 30,000 Km and sold the same car for 1 lakhs
  - OPEX for 5 Years:  $30K * 5 + 40K * 5 = \text{Rs } 3.5L$
- Cost per KM:  $(3L + 3.5L - 1L) / 30K = \text{Rs } 18.3/KM$

# Efficient Economic Model

- A Guy do not spend CAPEX (Rs 10L)+OPEX and used OLA/UBER
  - **No headache of driving**
  - **OLA Rs 12-15/KM**
  - Giving community service by using public CAB, some guy is getting earning
- Saved his money and invested some where?

# In Compute System Model

- CAPEX : Cost of the System + Places
- OPEX : Operational Cost
  - Energy Cost, Cooling Cost (significant)
- How to Reduce OPEX
  - **Energy Efficient Scheduling of JOBs to machines**
  - **Efficient Cooling of System**
  - **Next some lecture will be based on this**
- **Many house designs are Energy Efficient**
  - **Get good natural lighting at day time for all the rooms**
  - **Design for proper ventilation: AC/Fan requirement is less**

# IIT Guwahati HPC Example

- Capital Expenditure CAPEX (Rs 12 Crores)
  - 12 Crores for 3800 processors HPC System
    - 3-5 Year Life time, Need to be upgraded after 5 year
  - Space and AC Cost : 1 Crores
- Operational Cost OPEX
  - Electricity 50 Lakhs/Annum
  - AMC to OEM : 1.5 Crores/Annnum
  - Software 1 Crores/Annum
- Cost of Computing :  $13 + 5 * 3 = 28$  Crores/5 Years
- Cost of Computing : 5.6 Crores/Years

# IIT Guwahati HPC Example

- Cost of computing : 5.6 Crores/Years
  - Rs 14,736 per CPU Cores/Year
  - Rs 40.37 per CPU Core /Day
  - Rs 1.68 per CPU core/Hour
- <https://aws.amazon.com/savingsplans/pricing/>
- HPC Service Provide in Cloud Models in India  
<http://www.serc.iisc.ac.in/services/for-non-iisc-users/>
  - Rs 1.18 per CPU hour (Academic)
  - Rs 4.72 per CPU hour (Industries)

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# IIT Guwahati HPC Example

- Cost of computing of IITG HPC
  - 5.6 Crores/Years
- Instead by taking Rent from IISc Cloud
  - Rs 1.18 per CPU hour (Academic)
  - Rs 3.92 crores /Year for 3800 CPU per year
  - **IIT G could have Save 1.7 crores**
- Many Cloud provider offer at lesser price
  - Rs 0.6 per CPU hours
  - Rs 1.96 crores /Year for 3800 CPU per year
  - Instead of Spending 5.6 crores at IITG

# How CPU hour from cloud provider can be cheaper?

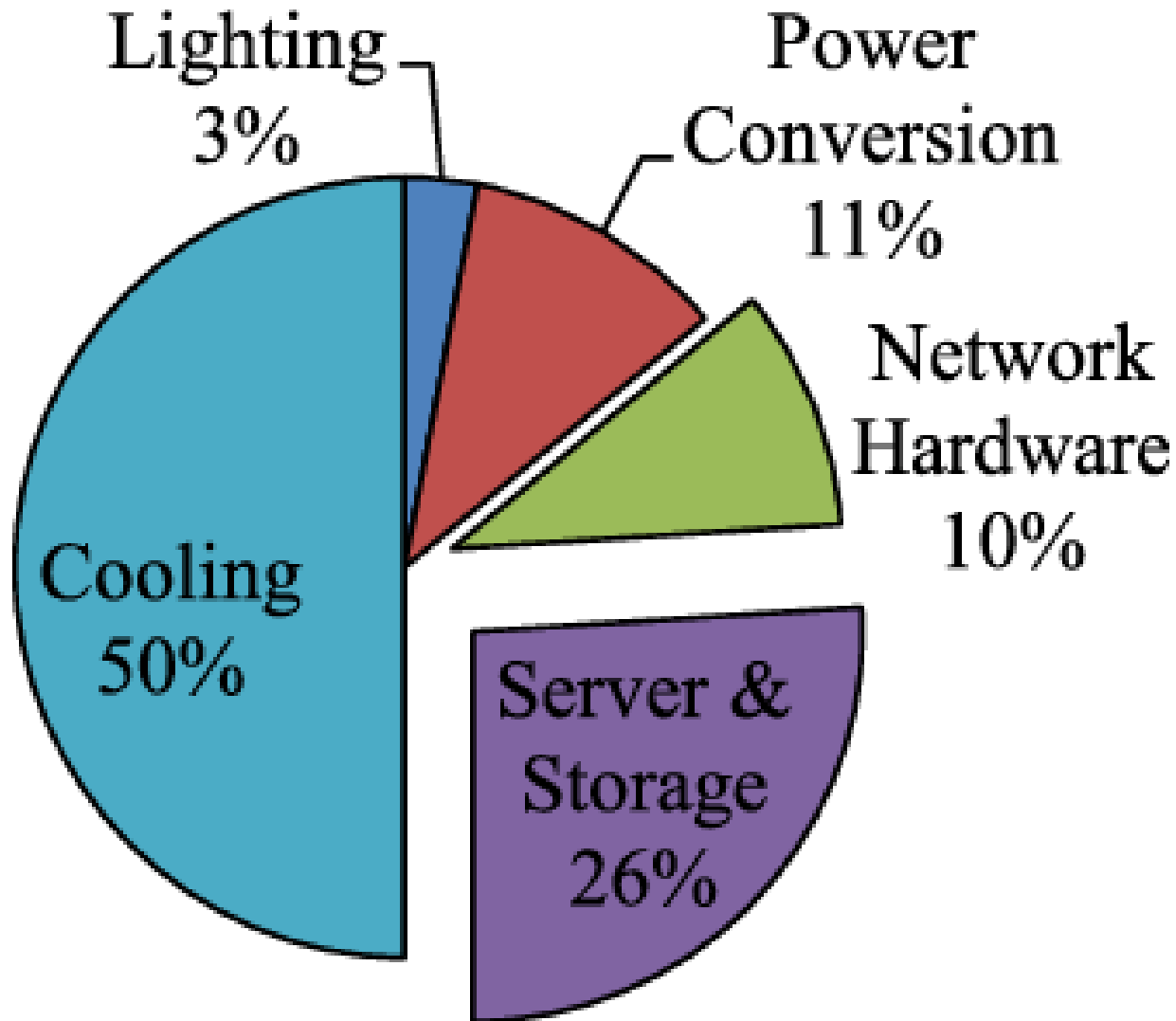
- Same as Reebok Shoes is cheaper in Amazon.in/Flipkart.com as compared to Showrooms of the City
  - No show room for Amazon/Flipkart, save a ton in CAPEX
  - No AC, Electricity for Showroom: save OPEX
  - Store room can be at Remote Places where cost of land is low
  - **Website and delivery : mass scale cheaper**



# How CPU hour from cloud provider can be cheaper?

- Same as Reebok Shoes is cheaper in Amazon.in/Flipkart.com as compared to Showrooms of the City
- Get the product from company in Bulk,
  - eligible for higher discount from Manufacturer : reduced supply chain
- For most of the Item
  - **Manufacturing cost is around 14%-22% of MRP**
  - **Company spend a lot in Advt (15-25%), and Supply chain**
  - **Bulk purchase : up to 50% of MRP**

# Energy Consumption Breakdown of Cloud Data Center



# How to Reduce compute cost IIT Guwahati

- Capital Expenditure CAPEX (Rs 12 Crores)
- 12 Crores for 3800 processors HPC System
  - Sol : Bargain with OEM not with middle man: deal could have in 8-9 crores
- Space and AC Cost : 1 Crores
  - Sol : Get a remote cheaper and Cooler location, may be in Tawang, AP
  - AC consume huge amount of Power 😊 😊
  - Fun: “Google INC have put CLOUD System in the SEA”

# How to Reduce compute cost IIT Guwahati

- Operational Cost OPEX : 3 Crores/Annum
- Electricity 50 Lakhs/Annum
  - Use Green Energy, solar, wind, etc.
  - Good Scheduler to reduce Energy
- AMC to OEM : 1.5 Crores/Annnum
  - Most Significant OPEX cost
  - Sol: Train your own man power to do the AMC instead of giving to third party
    - Example: Cost of repairing at OEM service center is costly.  
Get pricing feedback of service at OEM service center
- Software 1 Crores/Annum :
  - Shared license with others

# Cloud Computing Economic Benefits

- Most identifiable economic benefit of cloud computing is
  - direct cost savings, which occur from changes within the organization and the data centers that house the IT infrastructure.
  - **Supply Side – Large scale data centers lower cost due to superior buying power**

# Cloud Computing Economic Benefits

- Other economic benefit of cloud
  - Demand Side – Allowing multiple users across varying industries regions & time zones allowing for server utilization
  - **Multi-user efficiency – Increasing # of users lowers server cost per tenant**
  - **Data center efficiency – Advanced data center designs reduce power loss and improved cooling**

# Energy Efficient System: Design and Management

- **Point to consider**

1. Energy efficient Infrastructure
2. Energy Model of Infrastructure
  - Blades/Server Machine CPU, Memory
3. Energy Efficient Scheduling
  - How to manage the Jobs