

Green and Sustainable Computing

Green Cloud Computing

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Cloud Computing

- **Cloud Computing is a model for enabling convenient on demand network access to a shared pool of configurable resources that can be rapidly provisioned or rapidly released with minimal management effort of service provider interaction**
- **Models**
 - **Infrastructure as a Service**
 - **Platform as a Service**
 - **Software as a Service**
- **Deployment**
 - **Public**
 - **Private**
 - **Hybrid**
 - **Community**
- **Key Characteristics**
 - **On Demand Service**
 - **Broad Network access**
 - **Resource pooling**
 - **Rapid elasticity**
 - **Measured Service**

Environmental Issues in Cloud Computing

- Cloud portrayed as green in comparison with traditional delivery of IT Services
- Claims based on flawed methodology, lack of transparency and actual data.
- Misguided assumption that energy efficiency is alone a measure of environmental impact.

Factors of Energy consumption in Cloud

- Application Design
 - Normally designed to consume more energy, CPU and memory resulting in more power consumption.
- Software Stack
 - Due strict SLA's cloud providers use more resources than required
- Network Devices
 - With speeds of 1GB energy consumption increases even if there is no network consumption. Hence network resources should be used judiciously

Factors of Energy consumption in Cloud-Contd

- Data Centres

- The heart of the cloud is the data centre and these consume a tremendous amount of energy
- As per Green peace 2012 report, electricity consumption by data centres is nearly equal to that of 180,000 homes.
- Estimates of data center electricity demand is 31 GW with 19 % growth in 2012 alone.

Cooling device (Chiller, Computer Room

Air Conditioning (CRAC))

33%+9%

IT Equipment

30%

Electrical Equipments (UPS, Power

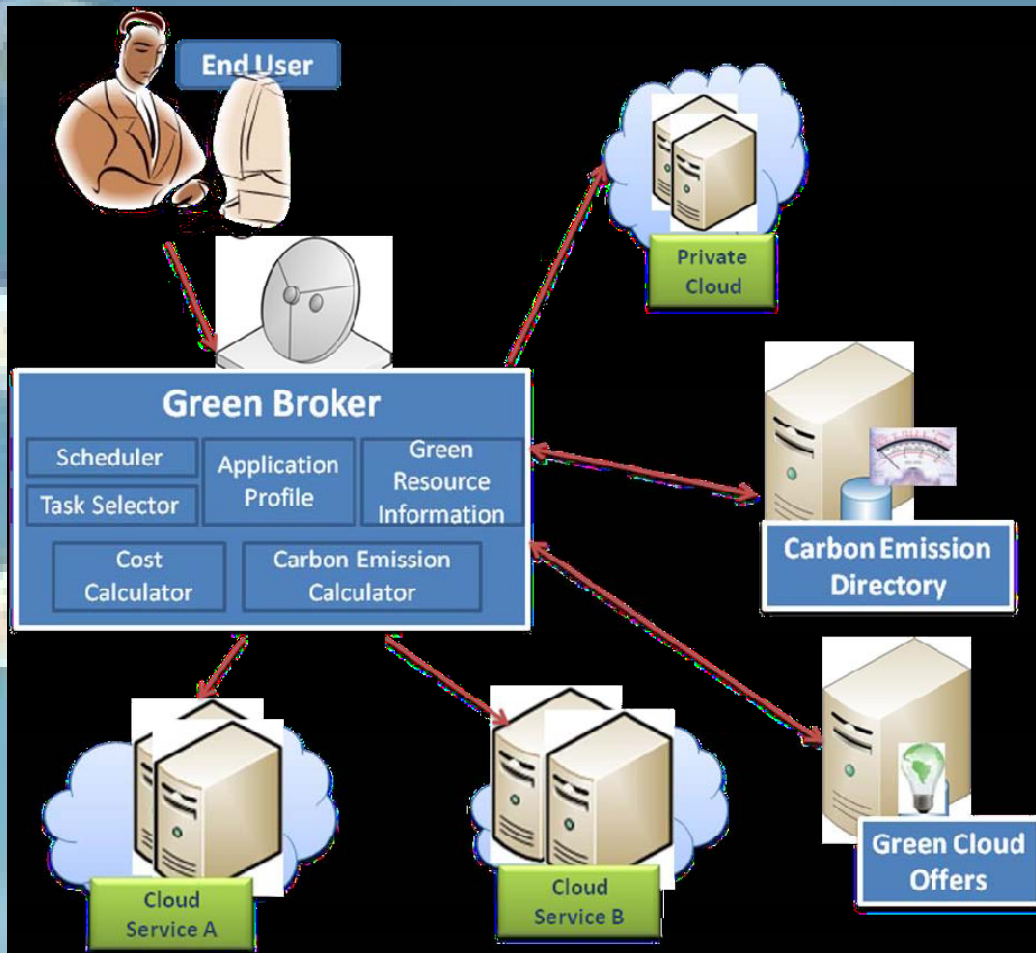
Distribution Units (PDUs), lighting)

28%

Key factors for energy consumption reduction

- Key driver- Virtualisation
- Four key factors
 - Dynamic Provisioning- virtual machines live migrated to other machines to maintain optimum number of active servers as per demand.
 - Multi tenancy- Multiple companies are served by the same infrastructure
 - High server utilisation of 70 % in cloud data centres as opposed to 5-10 % in individual data centres
 - Increased energy efficiency of data centres

Green Cloud Architecture



Cleaning our cloud

- Energy efficiency \neq green
- Source of electricity to be factored
- Direct investing /purchasing of renewable energy
- Location matters
 - Temperature range of location
 - Use of free cooling or outside air
 - Availability of clean electricity

Cloud Computing-Indian Scenario

- Gartner Sep 2013 report- Public Cloud market growing at 37.5 %
- As of May 2013- 54 private data centres across 13 cities.
- In house data centres crossed 50,000
- Data centre space expected to touch 6.2 million sq ft by 2016 (5.2 million sq ft in 2012)

Top cloud service providers in India

- Infosys – Bangalore
- TCS – Mumbai
- Wipro Technologies – New Delhi
- Zenith InfoTech – Mumbai
- Synapse India – Noida
- App Point – Bangalore
- CtrlS – Hyderabad
- Clogeny – Pune
- Eaze Work – Noida
- Net Magic Solutions – Mumbai
- Tata Communications – Mumbai
- Orange Scape – Chennai
- Ozonetel Systems – Hyderabad
- PK4 Software – Bangalore
- Ramco – Chennai
- Reliance Data Center – Mumbai
- Synage – Mumbai
- Wolf Frameworks – Bangalore

Tulips Green Data Centre- Bangalore

- Multi-tiered facility built to tier 4 and tier 3 standards.
- Third largest data centre in the world and Asia's largest data centre
- 900,000 sq ft centre with 20 modular data centre in four tower arrangement
- 100 MW of power
- LEED Gold Certified
- Air cooled and water based chillers for cooling
- Was expected to achieve PUE of 1.5. Actual as per website 1.94
- Rainwater harvesting,
- Numerous generators with 4 megawatts of capacity each,
- An anti-fire system,
- More than 30 chillers on the roof for providing cooling.
- On the ground floor are 16 generators (four more are outside),
- A state-of-the-art network operations center (NOC) with an integrated management system,

Conclusion

- Indian data centres performed slightly better on average as compared to their US counterparts. PUE of US data centre 1.81
India -1.78
- However the study conducted in September 2010 identified a range of performance in Indian data centres which confirmed a scope for improvement



Thank you