CS6006 - CLOUD COMPUTING

Module 9 - Cloud and Advanced Technologies

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CLOUD AND ADVANCED TECHNOLOGIES

- Use of Clouds for HPC/HTC and Ubiquitous Computing
- Performance Metrics for HPC/HTC Systems
- Quality of Service in Cloud Computing

CLOUD AND ADVANCED TECHNOLOGIES

- Data-intensive applications and future trends of Internet clouds are discussed in this section, along the lines of supporting mobile computing, ubiquitous computing, and social networking.
- We assess the development trends of both public and private clouds, as they appear in many high-performance or ubiquitous applications.

Use of Clouds for HPC/HTC and Ubiquitous Computing

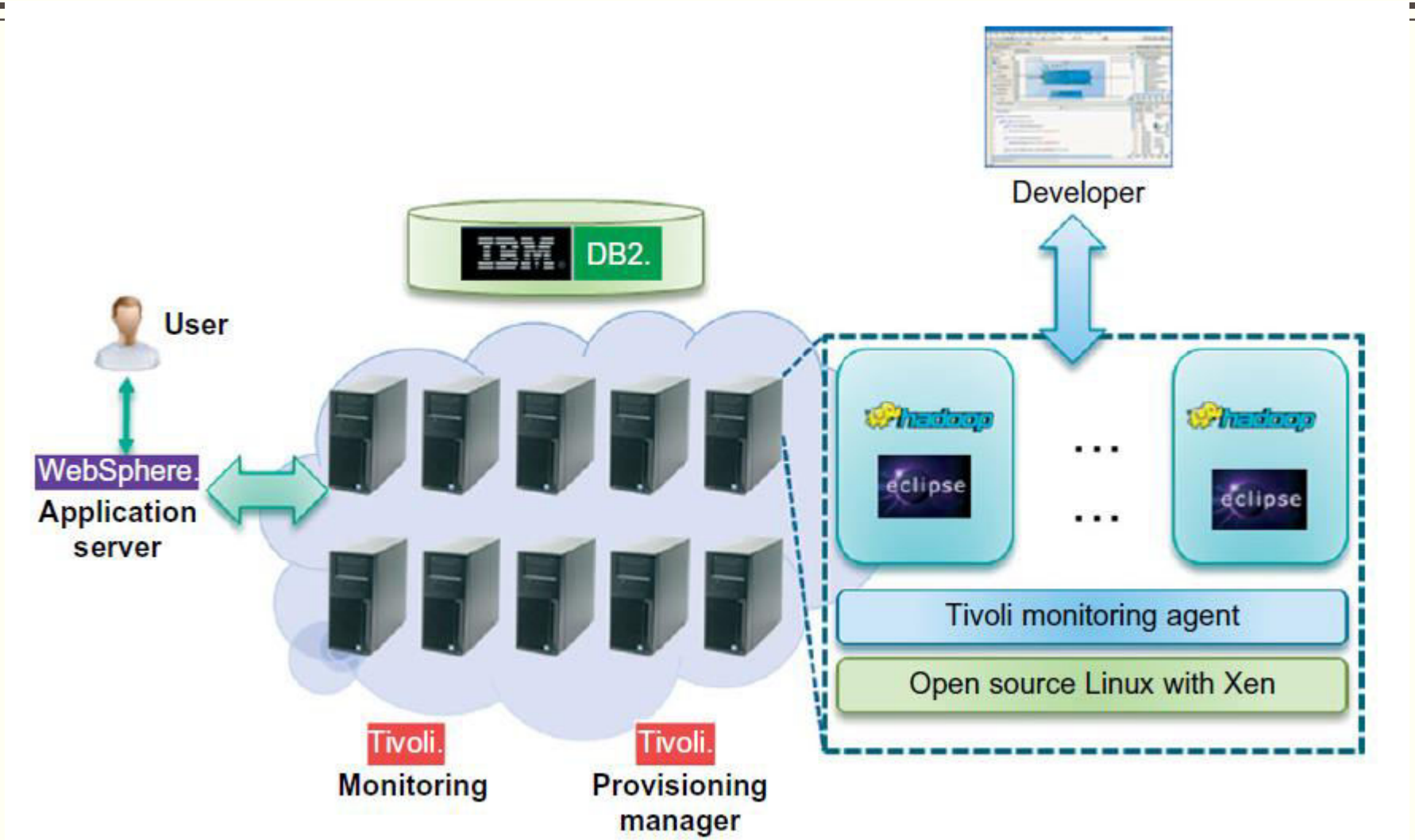
- Ubiquitous cloud computing refers to the use of Internet resources at any place and any time for any objectives.
- Today, people can access the Internet via a fixed wire or a mobile wireless connection.
- Science in the cloud has been impacted with a new research environment that leverages software and services being provided on user demand.
- New advances in research discovery are expected in high-energy physics, observatory astronomy, atmospheric modeling, and biomedicine.
- Herbert Simon on Information Consumption
- Vannevar Bush on Predicting Memex
- Cloud Service Trends
- IBM Cloud Projects
- IBM RC2 Cloud
- Cloud System from SGI
- Salesforce.com's Force.com Cloud

Use of Clouds for HPC/HTC and Ubiquitous Computing

Table 9.1 Some IT Companies Providing Cloud Services or Products

Company, Year	Major Cloud Offerings	Major User Groups
Amazon Seattle, 1994	Amazon Web Services (AWS); six Infrastructure-as-a-Service (IaaS) systems including EC2 for computing capacity and S3 for on-demand storage capacity	10,000 businesses and individual users including the *New York Times*, *The Washington Post*, and Eli Lilly
Enomaly Toronto, 2004	Elastic Computing Platform integrating enterprise data centers with commercial cloud offerings, managing internal and external resources with virtual machine (VM) migration	Business Objects, France Telecom, NBC, Deutsche Bank, Best Buy
Google Mountain View, CA, 1998	GAE offering Platform-as-a-Service (PaaS) capability plus office productivity tools including Gmail, calendar tools, the Postini web site creation tool, and security protection services	Small businesses, enterprises, and colleges including Arizona State University and Northwestern University
GoGrid San Francisco, 2008	Offers web-based storage and deploys Windows- and Linux-based virtual servers in the cloud with preinstalled software from Apache, PHP, and Microsoft SQL	Mostly startups, Web 2.0, and Software-as-a-Service (SaaS) companies, plus a few big names like SAP and Novell
Microsoft Seattle, 1975	Azure offering a Windows-as-a-service platform consisting of the OS and developer services that can be used to build and enhance web-hosted applications	Epicor, S3Edge, and Micro Focus using Azure to develop cloud applications
NetSuite San Mateo, CA, 1998	A business software suite including e-commerce, consumer relationship management (CRM), accounting, and enterprise resources planning (ERP) tools	Business customers such as Puck Coffee and Wrigleyville Sports
Rackspace San Antonio, TX, 1998	Mosso cloud offering a platform for building web sites; cloud files for a storage service; and Cloud Servers, an EC2-like service that provides access to virtualized server instances	Web developers and SaaS providers such as Zapproved, which uses Mosso to deliver an online productivity tool
Saleforce.com San Francisco, 1999	Offers CRM tools for sales force automation, analytics, marketing, and social networking; Force.com offers a PaaS for building web applications on the Salesforce.com infrastructure	500,000 customers in financial services, communications, and media, energy, and health care

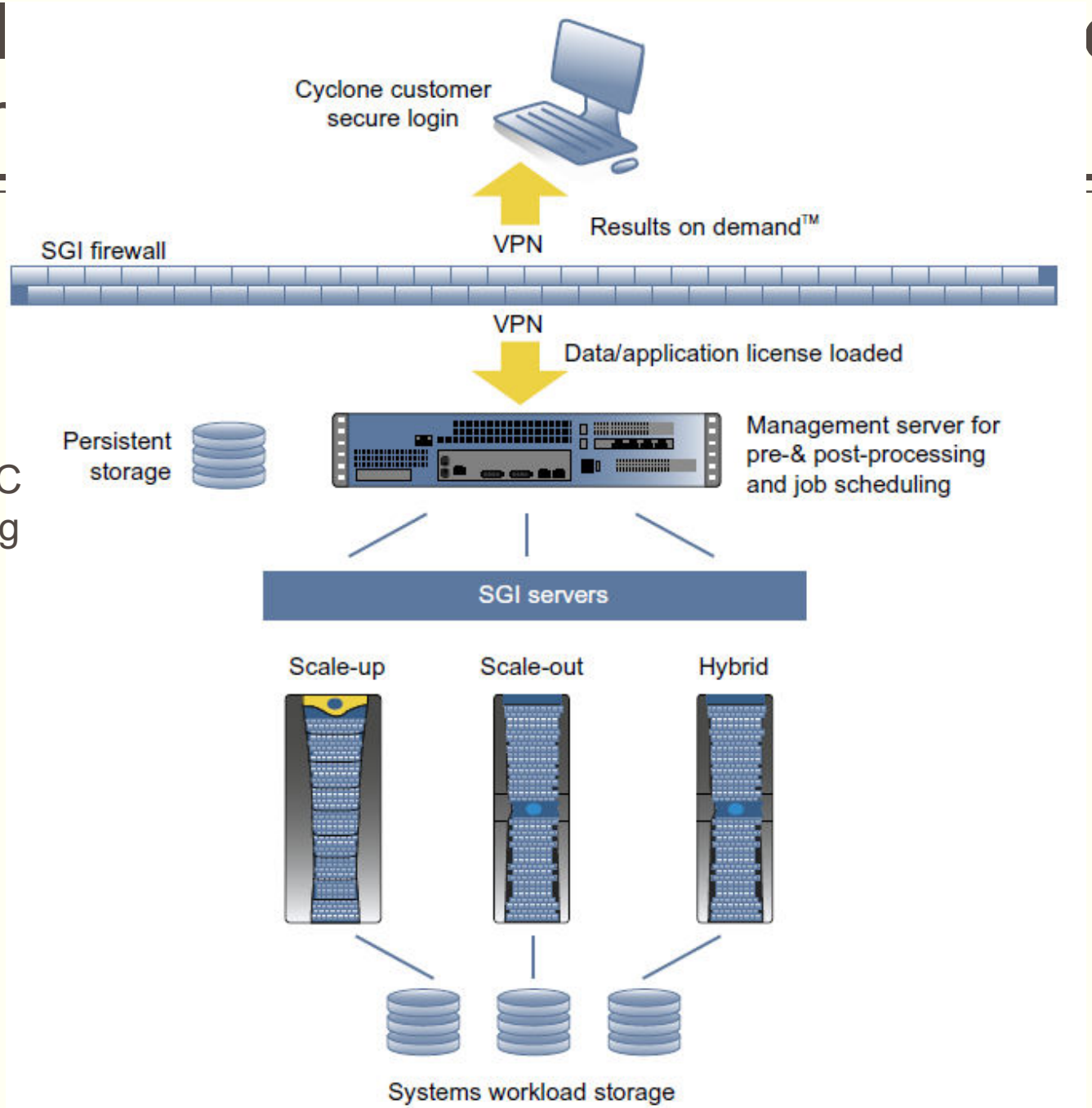
Use of Clouds for HPC/HTC and Ubiquitous Computing



Architecture of the BlueCloud system built with IBM hardware and software along with some open source Linux and Xen

Use of Cl ous Computir

SGI Cyclone HPC cloud for enabling SaaS and IaaS applications



Use of Clouds for HPC/HTC and Ubiquitous Computing

- **Large-Scale Private Clouds at NASA and CERN**
- In 2010, two large-scale private clouds were under construction in the United States and European Union.
- We discuss them in this section to demonstrate the scalable growth of cloud computing platforms.
- The U.S. cloud, called Nebula, is developed by NASA and is designed for NASA scientists to run climate models on remote systems provided by NASA.
- This can save thousands of NASA users from acquiring supercomputers at their local sites.
- Furthermore, it enables NASA to build the complex weather models around its data centers, which is more cost-effective.

PERFORMANCE METRICS FOR HPC/HTC SYSTEMS

- HPC performance has been well defined over the years.
- The most popular metrics used are Gflops and Tflops in the past, Pflops on top systems now, and Eflops for the future.
- Parallel benchmarking programs are available to evaluate HPC systems in batch processing of a large-scale problem.
- Well-known benchmark programs include the Linpack Benchmark, NAS, Splash, and Parkbench.
- On the other hand, HTC performance on business servers, clusters, data centers, and cloud systems is much more complex a problem to evaluate because the systems are used by many clients simultaneously.

PERFORMANCE METRICS FOR HPC/HTC SYSTEMS

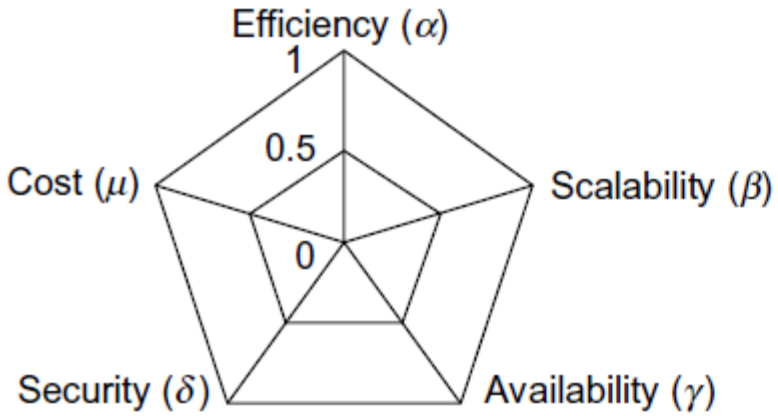
- Basic Performance Attributes
- System Throughput and Efficiency
- Multitasking Scalability
- System Availability
- Security Index
- Cost Effectiveness

QUALITY OF SERVICE IN CLOUD COMPUTING

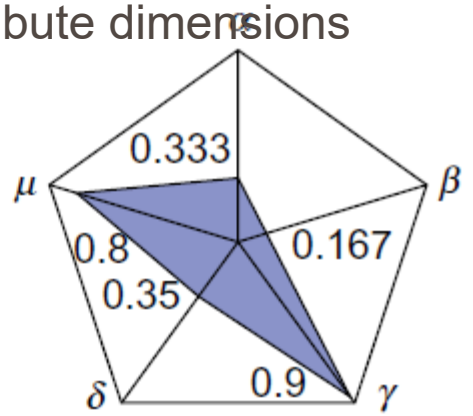
- We present the cumulative performance of a cloud platform by a compound metric, called quality of cloud services (QoCS) and denoted by θ.
- This metric measures the overall quality of the cloud service, regardless of the particular service models applied.
- We use a five-dimensional Kiviat graph to plot the aggregated cloud performance or to quantify the QoCS graphically.
- Each Kiviat graph has five orthogonal dimensions, representing the five performance attributes we introduced earlier.
- The Kiviat graph provides a holistic view of the capabilities of the cloud service model.
- The shaded area of the Kiviat graph represents the cumulative strength or quality of the cloud service being provided.

QUALITY OF SERVICE IN CLOUD COMPUTING

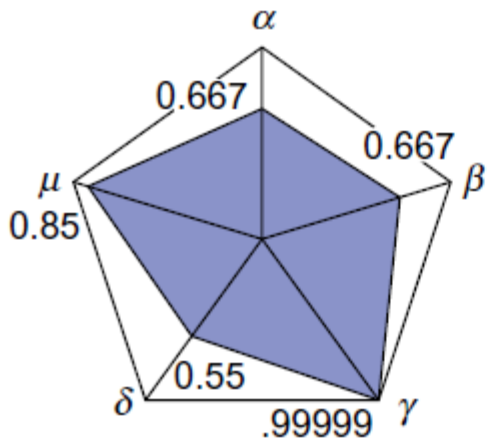
Kiviat graphs showing the QoCS of three cloud service models under assumed running conditions on five attribute dimensions



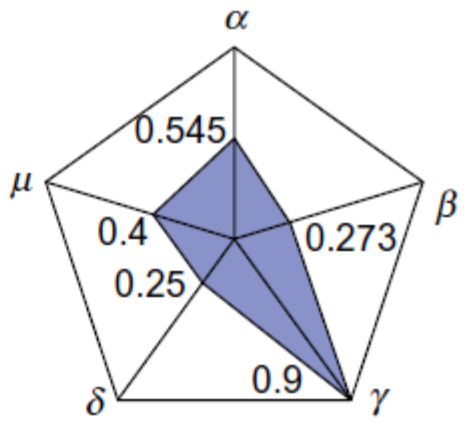
(a) Kiviat graph (template) with five attributes



(b) SaaS with low efficiency, scalability, and security



(c) PaaS under very good running conditions



(d) IaaS under poor running conditions but with HA

QUALITY OF SERVICE IN CLOUD COMPUTING

Table 9.5 Relative Performance of Three Computing Cloud Service Models Applied to an EC2 Application under Two Extreme Security and Availability Conditions

Service Model	QoCS of Cloud Services θ, under Worst-Case Scenario	Ranking Order under Worst-Case Scenario	QoCS of Cloud Services, θ, under Best-Case Scenario	Ranking Order under Best-Case Scenario
IaaS	19.3661%	3	59.7055%	1
PaaS	25.5026%	1	54.4187%	2
SaaS	22.2344%	2	52.1941%	3

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Thank You…