

## INFS 3204/7204 Service-Oriented Architecture



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Semester 2, 2011.

**M8: Cloud Computing Basic**

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## M8 Topics

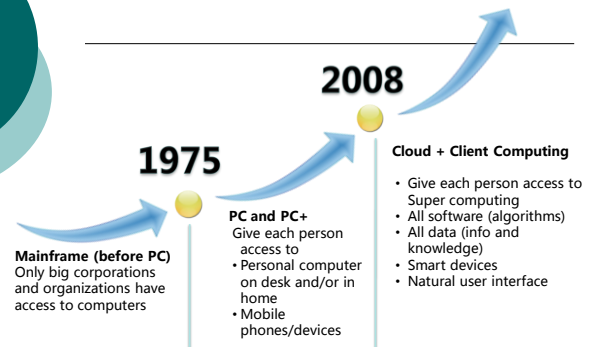
- Background
- Cloud computing
  - Concepts
  - Advantages and disadvantages
  - Cloud services
- A business case for cloud
- SOA meets cloud
- Future

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## Background

- Computing is about to change
  - Applications and data are moving from desktop into the cloud
  - "Cloud" consists of huge number of computers and servers, linked and accessible via internet
- How the way you work change
  - Single computer -> any computer
  - Facilitate group collaboration

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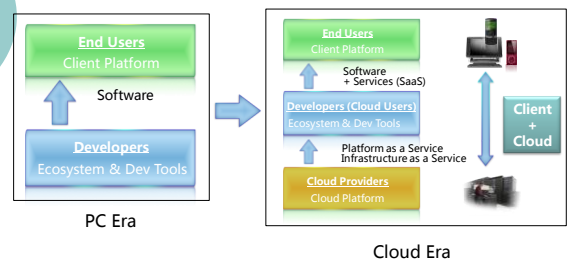
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## Beyond the Desktop

- Traditionally, PC-centric
  - Programs run on computers you own
  - Data stored in your PC
- Now, service-centric
  - Programs run on servers via internet
  - Data stored in remote servers

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## PC-Centric → Web as a Hub



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## Revolution of Computing

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- The emergence of cloud computing is the computing equivalent of the electricity revolution of a century ago
  - Before the advent of electrical utilities, business produced its own electricity from its freestanding generator. After the electrical grid was created, business shut down generators and bought electricity from the utilities, at a much lower price and with much greater reliability than they could produce on their own.

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## What Cloud Computing Isn't

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- Not networking computing
  - Where programs are hosted on a single company's server and accessed over the company network
- Not traditional outsourcing
  - Where a company farms out its computing services to an outside firm

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## What Cloud Computing Is?

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- "Cloud"? A large group of connected computers
  - PC or sever, public or private
- It is a pay-per-use model for enabling available, convenient, on-demand network access to a shared pool of configurable computing resources that can be rapidly provisioned and used with minimal interaction

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## Key Characteristics

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- On-demand self-service
- Ubiquitous network access
- Location and device independent resource pooling
- Rapid elasticity
- Pay-per-use

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## Google's Perspective

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- User-centric
- Task-centric
- Powerful
- Accessible
- Intelligent
- Programmable

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## Antecedents

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- Client-server computing
- Peer-to-peer computing
- Collaborative computing
- Grid computing
  - A Grid is a type of parallel and distributed system that enables the sharing, selection, and aggregation of geographically distributed 'autonomous' resources dynamically at runtime
  - The purpose is to solve large-scale resource-intensive problems that required more resources than a single computer (PC, workstation, supercomputer) could have provided in a single administrative domain

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## Is it simply a different wording of something we already have?

"...we've redefined Cloud Computing to include everything that we already do... I don't understand what we would do differently ... other than change the wording of some of our ads." Larry Ellison, CEO, Oracle

(Wall Street Journal, Sept. 26, 2008)

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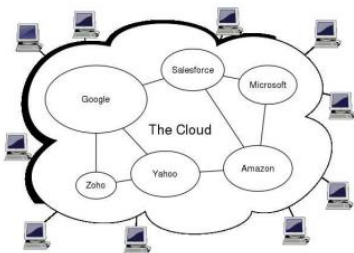
## A Paradigm Shift

- A shift in the geography of computation: from locally installed program to the "cloud"
- The "shift":
  - Mainframe 50 years ago: central site
  - PCs in isolation (1980s): "liberating" programs and data from the central computing centre
  - Cloud: functions migrating outward to distant data centres through the Internet. A client computer can communicate with many servers at the same time

Brian Hayes, *Cloud Computing*, ACM Communications 2008

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## New Wine or New Bottles?



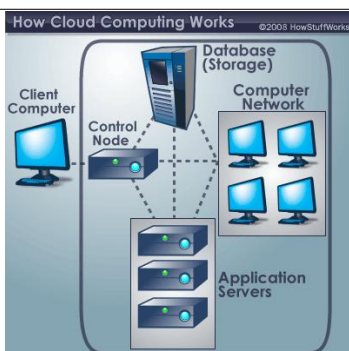
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## But, What is NEW after all

- The ability to leverage components from different cloud resources and mix and match the solution you want
- The commoditization of bandwidth to make them work like "local"
- The availability of innovative cloud providers for better services
- **Pay-as-you-go** utility computing

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## Cloud Architecture



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## Cloud Storage and Service

- Cloud storage
  - Virtual and static server locations
  - Stored on multiple servers and managed dynamically
  - Cheaper and more secure
- Cloud services
  - Any web application or service hosted in the cloud
  - An instance of service is created when accessed, and operates like standard desktop application.
  - Application and data remain in cloud

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## Cloud Computing Advantages

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- Low cost
  - Computers, disk space, infrastructure, maintenance, software cost, etc.
- Improved compatibility
  - Data formats, operating systems, etc.
- Improved performance
- Universal access to data
- Easier group collaboration
- Instant software update
- Tether removal to specific devices

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## Cloud Computing Disadvantages

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- Require constant and high-speed internet connection
- Slower than desktop application
- Features might be limited, e.g. PPT
- Data might not be secure
- If cloud loses data, you are screwed

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## Who Benefit

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- Collaborators
- Road warriors
- Cost-conscious users and business
- Users with increasing needs

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## Who Shouldn't Use

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- The internet-impaired
- Offline workers
- The security-conscious
- Anyone married to existing applications

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## Cloud Service Types

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- Software-as-a-Service (SaaS)
  - Delivery of software from the cloud to the desktop
  - Accessed via API over the web
- Platform-as-a-Service (PaaS)
  - Development environment is offered as a service
  - Provide a programming environment to build a cloud application
  - Use the "building blocks" (i.e. predefined blocks of codes)
  - The cloud deploys and manages the app for the client

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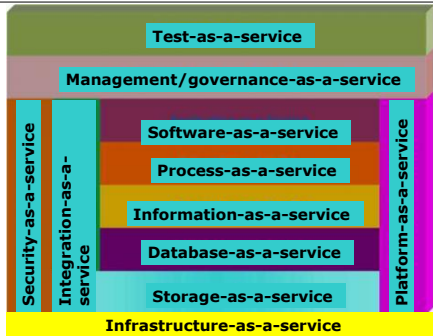
## Cloud Service Types

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- Infrastructure-as-a-Service (IaaS)
  - Provide a data center and a way to host client VMs and data
- Data-as-a-service (DaaS)
  - Provide data to the client
- And many others, such as storage-as-a-service, information-as-a-service, integration-as-a-service, security-as-a-service, etc

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## Services Illustration



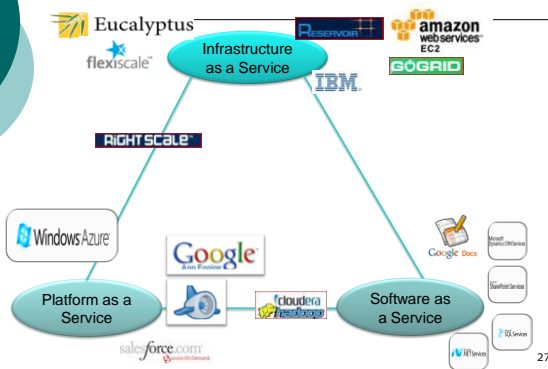
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## Some Cloud Service Providers

- Amazon
  - Elastic Compute Cloud (EC2), allows users and companies to rent capacity on Amazon's proprietary cloud of servers
- Google App Engine
  - Provides a fully integrated application environment, utilizing the same infrastructure that powers Google
- Microsoft, etc

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## The Cloud Landscape



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## Making a Business Case for Cloud

- Define the value points
  - Cost reduction
  - Value of preserving capital
  - Value of upsizing on demand
  - Value of downsizing on demand
  - Value of shifting the risk
  - Value of agility
  - Value of reuse
  - Value of leveraging new technology

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## Cost Reduction

	On-premise	Cloud
Hardware	\$	0
Software	\$	\$
Maintenance	\$	0
Data center	\$	0
Bandwidth	0	\$

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## Major Steps

- Understand the existing issues
- Assign costs
- Model "As is"
- Model "to be"
- Define values points
- Define hard benefits
- Define soft benefits
- Final proposal

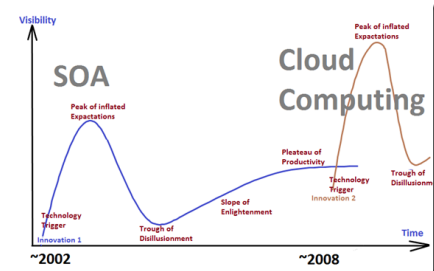
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## SOA Meets Cloud

- Cloud computing is the ability to provide any IT resource, including storage, database, application development, infrastructure, etc. The core idea is that it is much cheaper to leverage these resources as services, paying-as-you-go and as-you-need
- SOA can use cloud computing to leverage those resources outside of the enterprise firewall to cloud computing providers

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## Visibility



<http://blogs.msdn.com/b/usisvde/archive/2009/01/06/soa-is-dead-long-live-well-services.aspx>

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## Importance of SOA to Cloud

- It is a good architectural approach to deal with the formation of systems
- It is a good choice for enterprises to make most of cloud computing, where resources can be reached out
- It has architectural discipline with guiding principles to develop systems

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## Dream Team of SOA and Cloud

- Leverage cloud computing within the context of SOA
- Consider cloud computing the extension of SOA out to cloud services
- Determine which services are good candidates to reside in the cloud as well as which cloud services should be abstracted within the existing or emerging SOA
- Simply, clouds are just additional places to run things in SOA

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## SOA vs. Cloud

- SOA is a pattern of architecture, while cloud is an instance of architecture
- Cloud is nothing but a way to deploy architecture in a way that has the potential to be more productive and cost effective. It is a tool, not a way of life
- SOA is more holistic and strategic, while cloud is more tactical and is a way of solving problem

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## Moving Onward

- I never think of the future – it comes soon enough

- Albert Einstein

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## Future

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- Will most of core businesses and data be relocated in clouds?
  - Compliance, privacy, fear, control, etc
- Will cost saving continue to be a major driver for clouds?
- How will SOA and clouds exist together?
- What about the interoperability among cloud provider?
- What is the future?

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## Summary

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- This week:
  - Background
  - Cloud computing
    - Concepts
    - Advantages and disadvantages
    - Cloud services
  - A business case for cloud
  - SOA meets cloud
  - Future
- Next Lecture:
  - **Cloud computing advance**

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## References

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- Cloud Computing and SOA Convergence in Your Enterprise: A Step-by-Step Guide. David S. Linthicum. Addison-Wesley Professional, 2009.
- Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online. Michael Miller. Que, 2008.
- [http://en.wikipedia.org/wiki/Cloud\\_computing](http://en.wikipedia.org/wiki/Cloud_computing)

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