



Cloud Computing

- Platform as a Service

Agenda

- Introduction
 - From IaaS to PaaS
 - What is PaaS
 - PaaS properties and characteristics
- Cloud Platform
 - Case studies

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From IaaS to PaaS

What is PaaS

PaaS properties and characteristics

INTRODUCTION

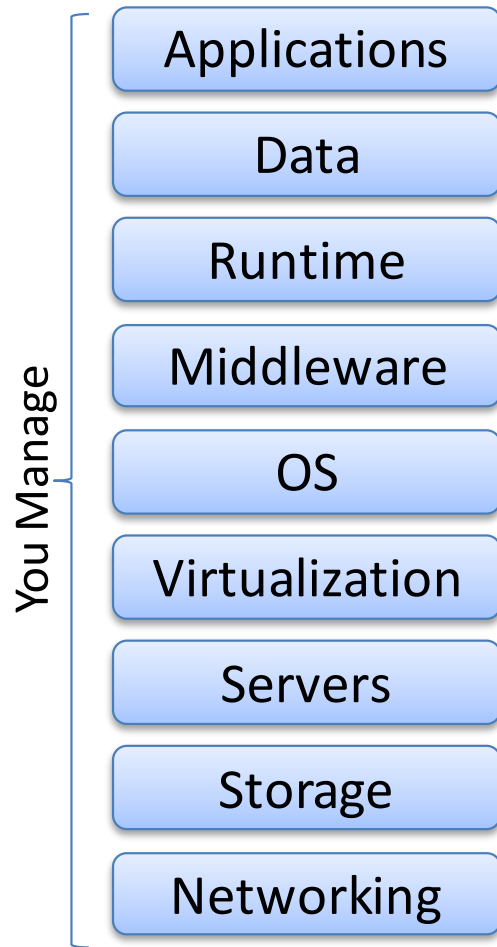
What Has IaaS Done

- IaaS provides virtual machines and resources such that IaaS vendors can segment resources for each user
- IaaS providers can also make users have no need to purchase the hardware
- IaaS can make better use of resources

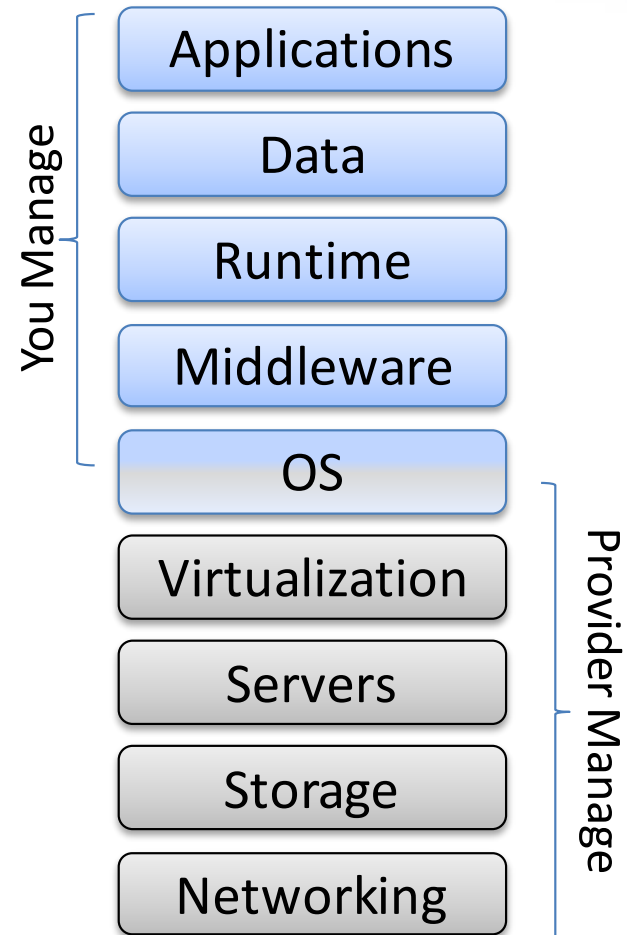
But is it enough?

What IaaS Can Do

- Traditional IT



- IaaS



IaaS is Not Enough

- IaaS provides many virtual or physical machines, but it cannot alter the quantity automatically
- Consumers might
 - Require automatic make-decisions of dispatching jobs to available resources
 - Need a running environment or a development and testing platform to design their applications or services

More Requirements

- Consumers require more and more...
 - Large-scale resource abstraction and management
 - Requirement of large-scale resources on demand
 - Running and hosting environment
 - Automatic and autonomous mechanism
 - Distribution and management of jobs
 - Access control and authentication
 - ...



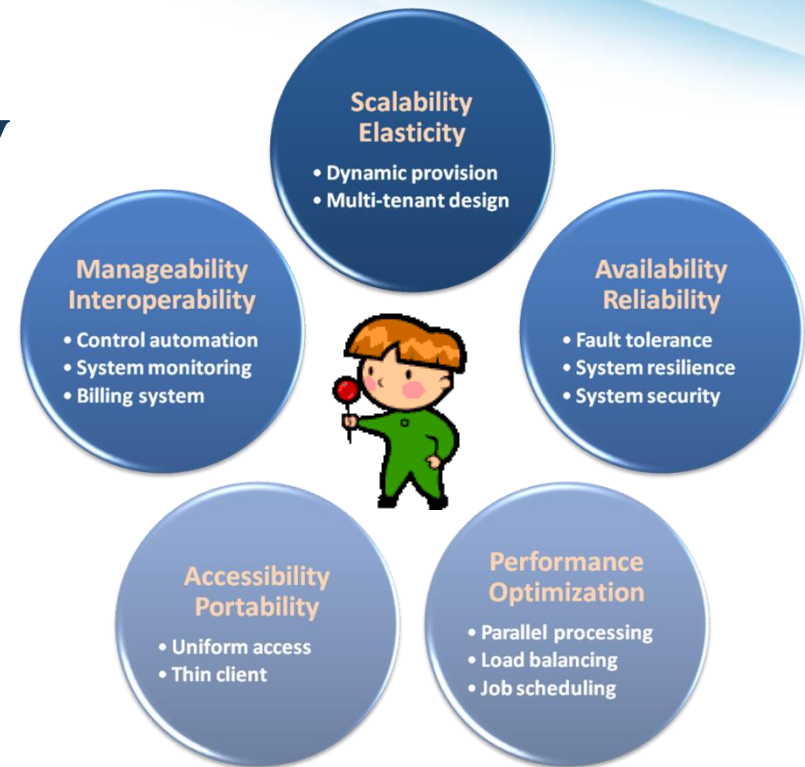
More and More...

We need more
services

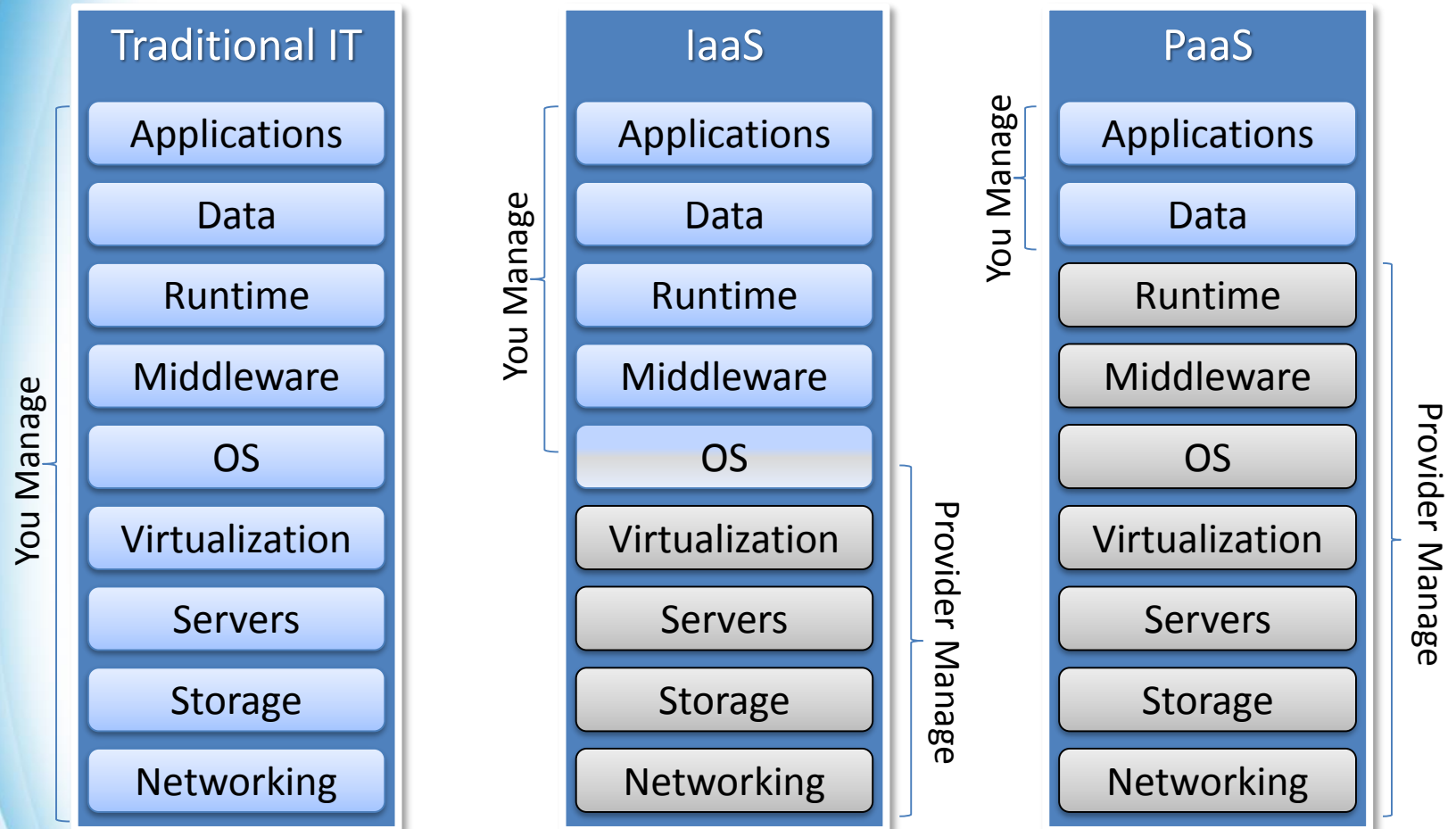


PaaS Buys It for You

- PaaS provides a series of properties that can satisfy user's requirements
- PaaS guarantees the quality of resources, services and applications



From IaaS to PaaS



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From IaaS to PaaS

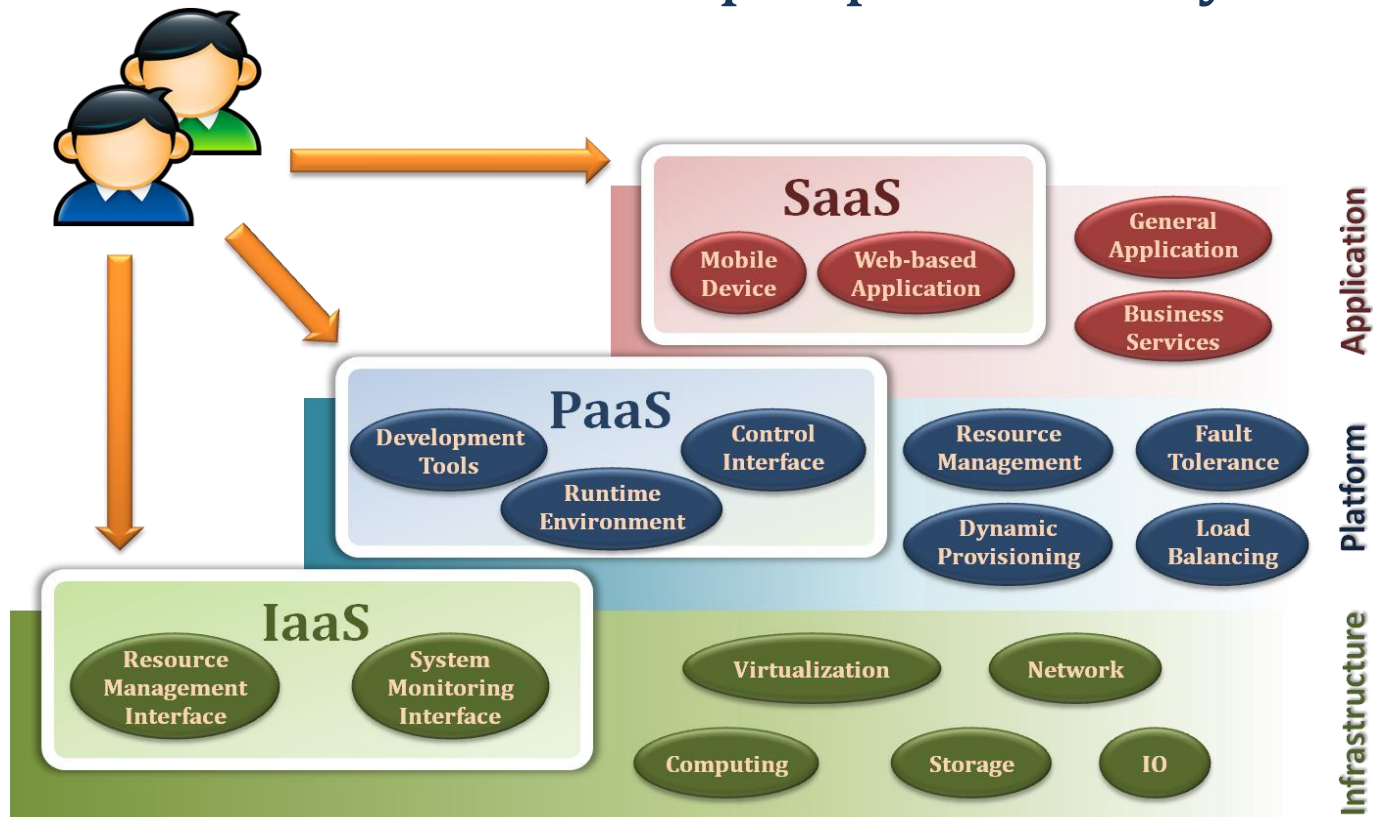
What is PaaS

PaaS properties and characteristics

INTRODUCTION

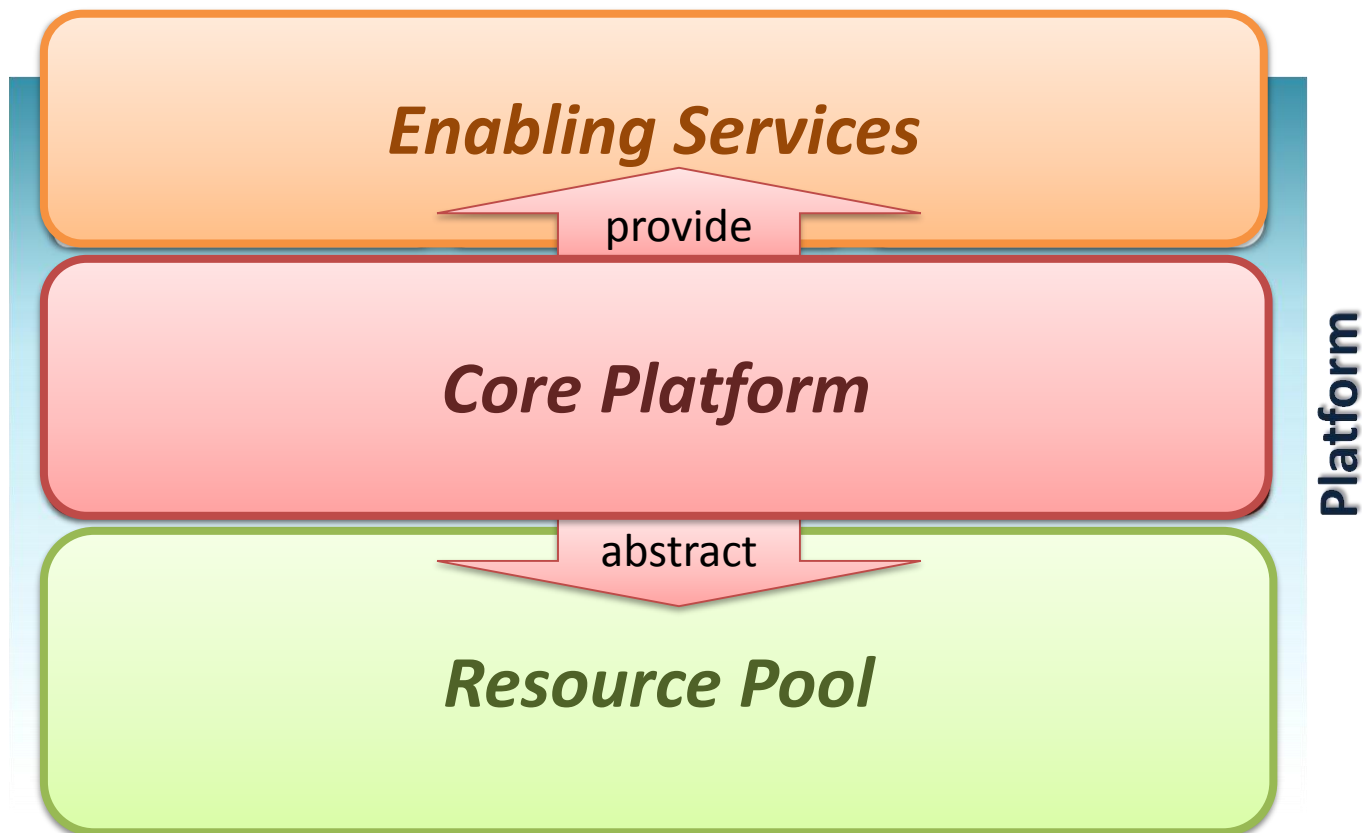
Platform as a Service

Platform as a Service (PaaS) is a computing platform that abstracts the infrastructure, OS, and middleware to drive developer productivity



Platform as a Service

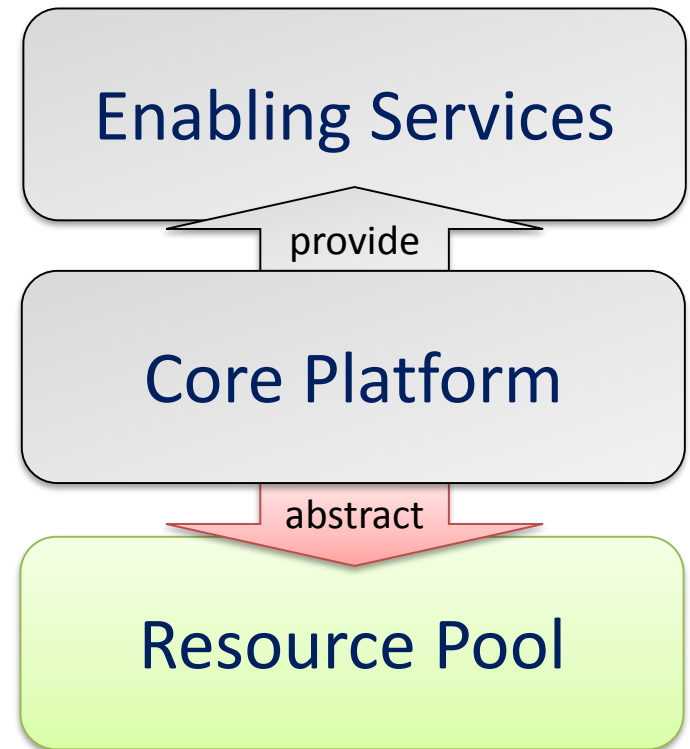
- Deliver the computing platform as a service
 - Developing applications using programming languages and tools supported by the PaaS provider
 - Deploying consumer-created applications onto the cloud infrastructure



Resource Pool

The capacities to abstract and control all the underlying resources

- Resource Pool dynamically provides an abstraction and consolidation of large-scale resources
- Consumers can acquire and return resources from the resource pool on demand



Resource Pool

- Reduce the complexity and responsibility of cloud infrastructure
- Provide the automatic management to provision resources
- Access resources from the resource pool on demand



Resource Pool

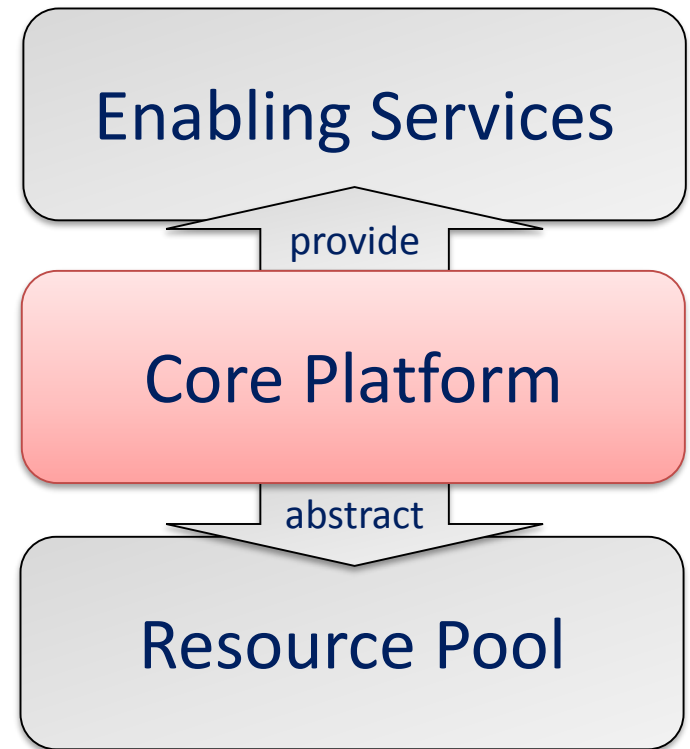
- PaaS providers define the smallest unit of resource
 - 1GHz CPU computation ability
 - 1GB storage space
 - 1MB memory capacity
 - ...etc
- PaaS consumers can require units on their demand
- Consumers may not be aware of whether provided resource is dedicated or shared



Core Platform

To provide a reliable environment for running applications and services

- Core Platform provides basic functionalities of a PaaS environment
- Act as a bridge between consumer and hardware



Core Platform

- Reduce the responsibility of the runtime environment
- Based on the core platform to develop their applications
- Do not need to care about how to build, configure, manage and maintain the backend environment



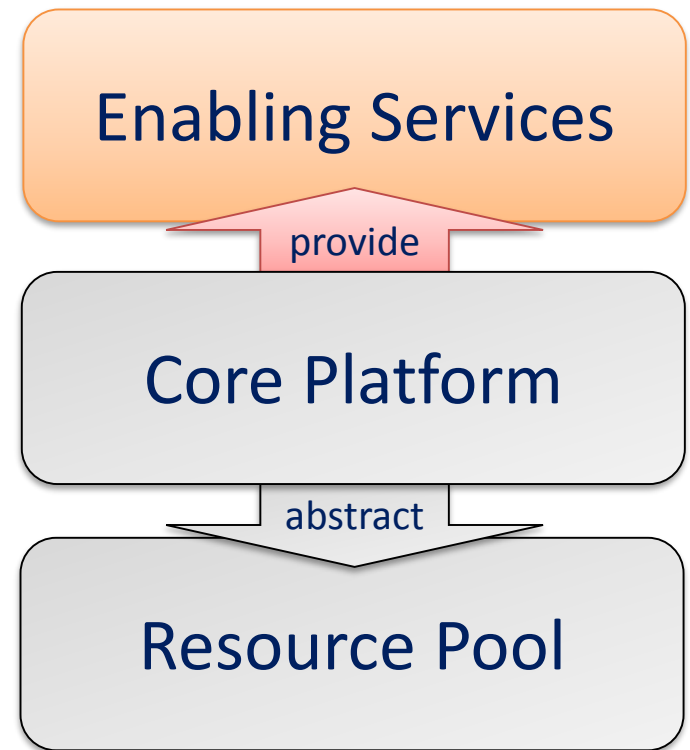
Core Platform

- PaaS providers can provide a runtime environment for the developer platform
- Runtime environment is automatic control such that consumers can focus on their services
 - **Dynamic provisioning**
 - On-demand resource provisioning
 - **Load balancing**
 - Distribute workload evenly among resources
 - **Fault tolerance**
 - Continuously operating in the presence of failures
 - **System monitoring**
 - Monitor the system status and measure the usage of resources

Enabling Services

To provide platform interfaces and services to drive the development productivities

- Enabling Services provide programming IDE and system control interfaces to access the PaaS environment
- Consumers can develop their applications through the APIs and development tools



Enabling Services

- Provide a development and testing platform for running developed applications on the runtime environment
- Reduce the responsibility of managing the development environment
- Decrease the development period



painful

Enabling Services

- Enabling Services are the main focus of consumers
- Consumers can make use of these sustaining services to develop their applications
 - **Programming IDE**
 - Integrate the full functionalities supported from the runtime environment
 - Provide some development tools, such as profiler, debugger and testing environment
 - **System Control Interfaces**
 - Make the decision according to some principles and requirements
 - Describe the flow of installation and configuration of resources

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From IaaS to PaaS

What is PaaS

PaaS properties and characteristics

INTRODUCTION

Platform as a Service

- Guarantee some properties and characteristics
 - Scalability
 - Availability
 - Manageability
 - Performance
 - Accessibility

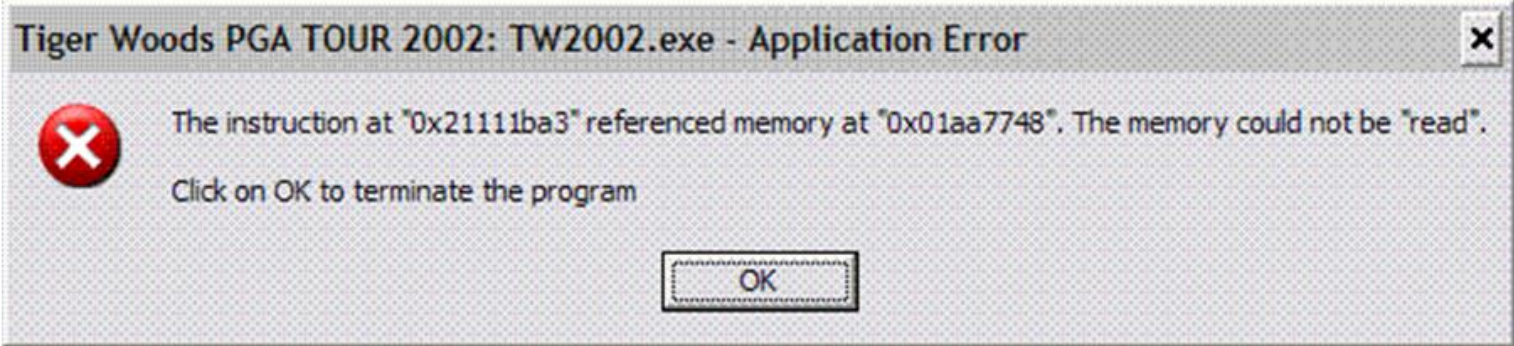
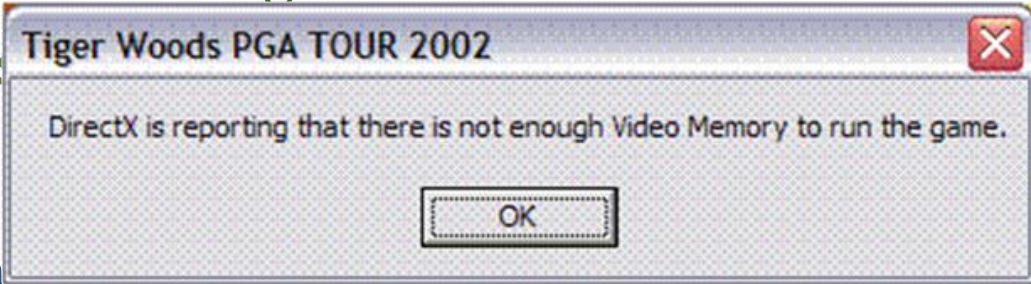



Scalability

- PaaS needs to support dynamic provisioning that can increase or decrease resources on demand
- PaaS provides the abstraction of cloud infrastructure and the automatic management



Scalability

-  Tiger Woods PGA TOUR 2002: TW2002.exe - Application Error
The instruction at "0x21111ba3" referenced memory at "0x01aa7748". The memory could not be "read".
Click on OK to terminate the program
OK
- It also slows down in the morning but slow down in the afternoon
- For end users, they could not play the game at the same time
- For end users, they could not play the game at the same time due to the lack of memory or storage space
 - For example...
 -  Tiger Woods PGA TOUR 2002
DirectX is reporting that there is not enough Video Memory to run the game.
OK
 -  Error Copying File or Folder
Cannot copy PatBentley - Clip 004: There is not enough free disk space.
Delete one or more files to free disk space, and then try again.
To free space on this drive by deleting old or unnecessary files, click Disk Cleanup.
Disk Cleanup... OK

Availability

- PaaS needs to support the fault tolerance ability such that system would not crash on failure
- PaaS also needs to provide system resilience by duplicating applications or services



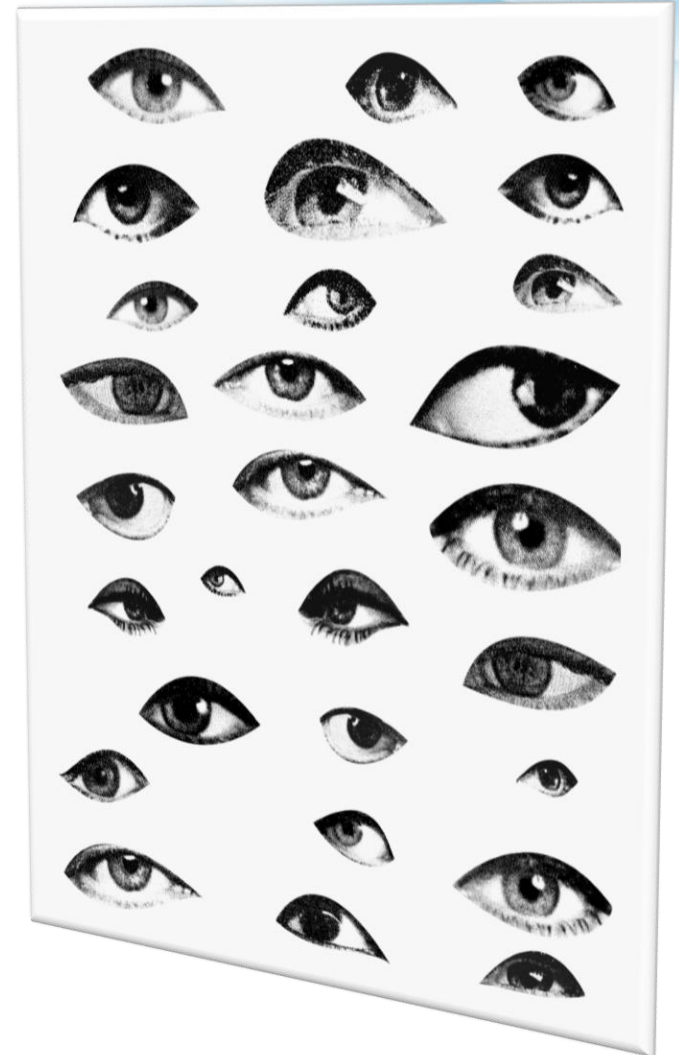
Availability

- PaaS supports automatic backup and disaster recovery such that consumers do not need to worry about system failures
- When some resources are failed, PaaS would start up the backup resources
- When application faults occur, PaaS would migrate services to the duplicate one

There is no error

Manageability

- PaaS needs to support self-management for running applications and services on the cloud platform
- PaaS needs to provide automatic control, analysis and measurement for the resource usage



Manageability

- PaaS provides automatic mechanisms to control the utilization of platform resources
- Monitoring service provides the ability of management, analysis and operation for resources and jobs
- Based on the system monitoring, PaaS can record and report the usage of resources
- Consumers can pay for what they use

Billing

- Consumers pay the bill according to how many units of resources and services they use
 - Input/output network bandwidth
 - Management report or warning
 - CPU time
 - Storage space
 - Data migration
 - ...etc



Billing

- Consumers can set the boundary they would not like to pay the overestimate
- PaaS vendor may provide the free quota for users
- PaaS vendor can also alert consumer the suddenly increased usage
- As a result, consumers only pay what they use on demand

Performance

- PaaS needs to support the capabilities
 - Distribute jobs to idle resources
 - Remove jobs from the overloading resources
- PaaS also needs to distribute data to storage system with load balancing



Performance

- Enterprise runs complicated applications on PaaS which can allocate jobs to available servers
- If possible, PaaS would run application in parallel
- No resource is always overloading on the load balancing PaaS
- Utilization and performance could be further improved

Security

- Security is an important characteristic in PaaS
- PaaS needs to provide authentication and authorization to differentiate the access rights of different users



Security

- Authorization can be used to control the user's access right and reject malicious requests
- Authentication is the act of establishing or confirming something or someone as authentic
- All of these can limit the malicious behavior

Accessibility

- PaaS needs to provide an interactive interface for consumers to access cloud services or monitor the system status
- Consumers could develop and test their applications via web browsers or other thin-clients



Summary

- PaaS is a magic box
 - Request anything on demand, and return the rent of resources dynamically
 - Automatically build an initial environment and support self-management with high quality of service and performance
 - Provide an ability of fault tolerance and disaster recovery that make services be more available and reliable
 - Support the security property to limit malicious behavior in cloud environments
- More important
 - Do not care about how it works
 - Pay as you go

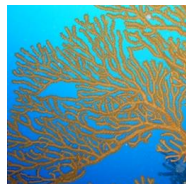
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Case Studies

CLOUD PLATFORM

PaaS Players

- PaaS venders
 - Microsoft Windows Azure
 - Hadoop
 - Google App Engine



AppScale





Microsoft Windows Azure

- Windows Azure platform is one of PaaS vendors
 - Based on .NET and Microsoft's supported development tools
- Windows Azure starts general availability at Feb 2010, and builds the global data center around the world

North American Data Centers

European Data Centers

Asian Data Centers



References

- Web resources:
 - Microsoft Windows Azure.
<http://www.microsoft.com/windowsazure/>
 - Chu's blog. <http://www.dotblogs.com.tw/regionbbs/>
 - From Wikipedia, the free encyclopedia.
- All resources of the materials and pictures were partially retrieved from the Internet