Basics of Cloud Computing – Lecture 6

Platform as a Service (PaaS)

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Several slides are taken from Pelle Jakovits

Google Cloud Platform

Google App Engine

Outline

- Introduction to PaaS
- Google Cloud
- Google App Engine
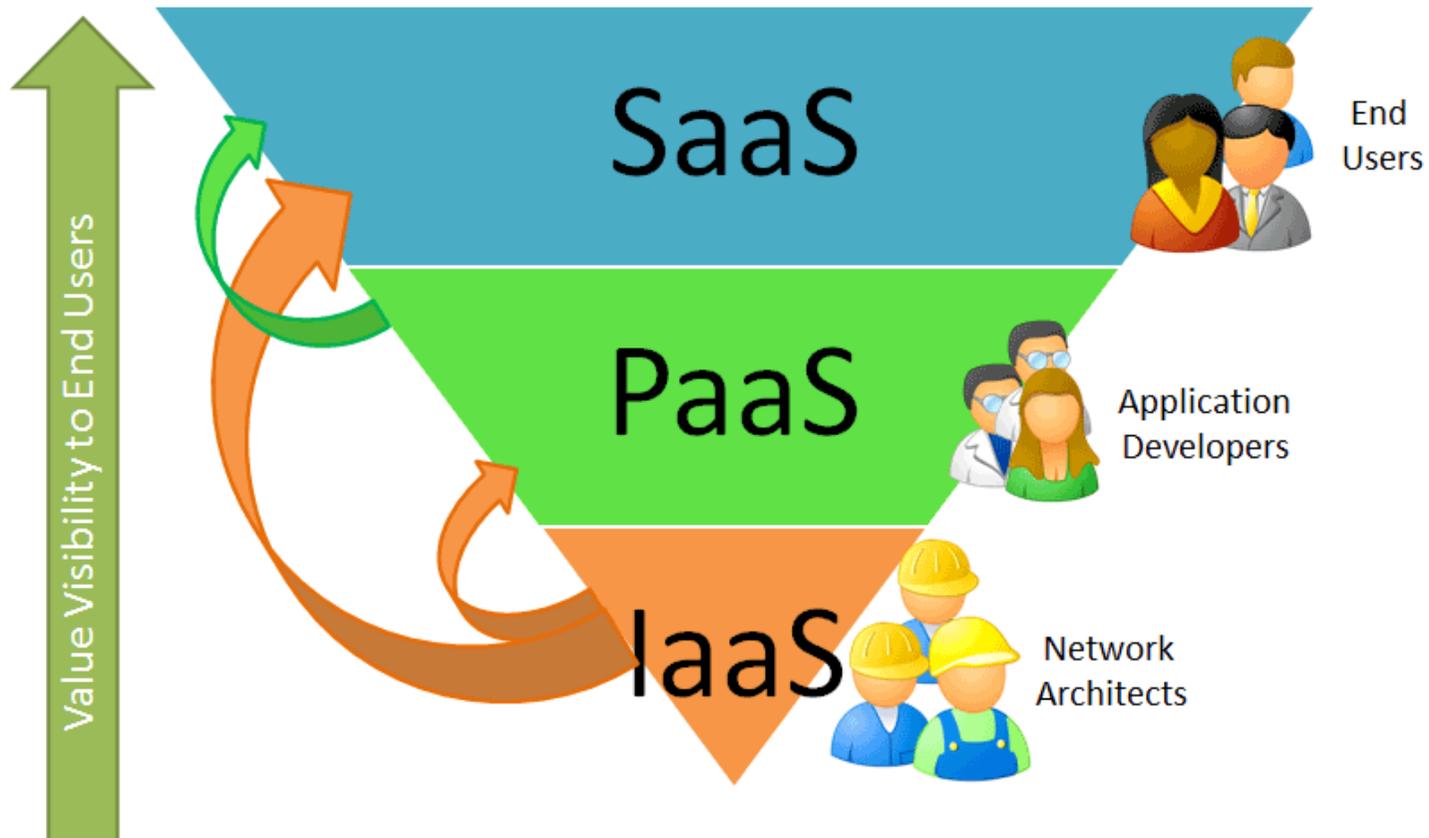- Other PaaS providers
- Advantages & disadvantages of PaaS

Background

- Until now we have discussed mostly IaaS
- IaaS mainly provides virtual machines and resources
  - User need not have to purchase the hardware
  - IaaS can make better use of resources (utilization)
- You already worked with OpenStack instances on SciCloud

Troubles with IaaS

- Need a running environment or a development and testing platform
  - To design applications or services
- Users still require automatic decision-making of dispatching of jobs to available resources
  - We already have discussed solutions for loadbalancing and auto-scaling
- Complete system administration and monitoring falls on the user's shoulders

Cloud Services

Value Visibility to End Users

SaaS — End Users
PaaS — Application Developers
IaaS — Network Architects

http://nolegendhere.blogspot.com.ee/2012/06/presentation-4-5-7.html

Platform as a Service - PaaS

- Complete platform for hosting applications in Cloud
- All the infrastructure is managed for you
- Enables businesses to build and run web-based, custom applications in an on-demand fashion
- Eliminates the complexity of **selecting**, **purchasing, configuring**, and **managing** hardware and software
- Dramatically decreases upfront costs

PaaS Characteristics

- Multi-tenant architecture
- Built-in scalability of deployed software
- Integrated with web services and databases
- Users are provided with tools to simplify creating and deploying applications
- Simplifies prototyping and deploying startup solutions

PaaS Characteristics - continued

- Users only pay for services they use

- More fine grained cost model

- Provides tools to handle billing and subscription management

- Typically introduces vendor lock-in

Types of PaaS

- Standalone Application Platforms
  - Typically built on top of an existing IaaS
  - Provides development tools for designing and deploying software
  - Provide all required computing resources and services needed for hosted applications
- Social Application Development Platforms
  - Used to develop add-ons and internal applications for social websites such as Google+ and Facebook
  - Integrated API with the social website platform
  - Can be seen as extending SaaS platform

Types of PaaS - continued

- Open-Computing Platforms
  - Not tied to a single IaaS provider
  - Goal is interoperability and supporting open-source platform tools
  - Supports applications that are written in numerous languages and that use any type of database, operating system, and server
  - E.g. Cloud Foundry, Red Hat OpenShift etc.

Google Cloud

- IaaS & PaaS services
- All services built on top of Google hardware located across the globe
  - Global redundancy and service locality
- Utilizes Google's Global network
  - Dedicated fiber optic networks
  - Even between continents
  - Multilevel location based data caching
- Google Managed Services
  - Database administration, server configuration, sharding and load balancing managed for the user

https://cloud.google.com/

Google Cloud Services

- Compute Engine
  - IaaS providing virtual machines similar to Amazon EC2
- App Engine
  - PaaS for directly hosting applications
- Container Engine
  - Powerful cluster manager and orchestration system for running your Docker containers
    - Docker uses the resource isolation features of the Linux kernel such as cgroups and kernel namespaces
    - Independent "containers" run within a single Linux instance
    - Avoids the overhead of starting and maintaining virtual machines

Google Cloud Services - Storage

- **Cloud Storage**
  - Object storage for applications
- **Cloud SQL**
  - Fully managed Relational MySQL
  - beta support for PostgreSQL
- **Cloud Datastore**
  - Automatically scaled NoSQL storage
- **Cloud BigTable**
  - NoSQL database for warehousing
  - A high performance NoSQL database service for large analytical and operational workloads

Google Cloud Services - continued

- Big Data
  - Big Query
    - SQL like queries against multi-terabyte/petabyte datasets
  - Cloud Dataflow
    - Managing data processing workflows
    - Supports both stream and batch execution of pipelines
  - Cloud DataProc
    - Managed data processing with Hadoop and Spark

- Cloud Endpoints
  - Create RESTful services to make your code accessible from iOS, Android and Javascript clients

Free Cloud Account

- Apply at https://cloud.google.com/free-trial/
- $300 Credit for 12 months
- Maximum limit of 8 cores at a time for instances
- Need credit card to sign up
- Won't be billed until upgrade to paid account
- Only the portion of usage above the App Engine free daily quota is charged against credit
- Several other services are also available for free

Google App Engine

Google App Engine

- PaaS for developing and hosting web applications in Google-managed data centers
- Easy to build, maintain, and scale applications
- No servers to maintain or configure by yourself
- Upload & Go
- Was created before Google Cloud became available for public use
- Supported languages
  - Python, Java, PHP, Go

Deployment Life Cycle
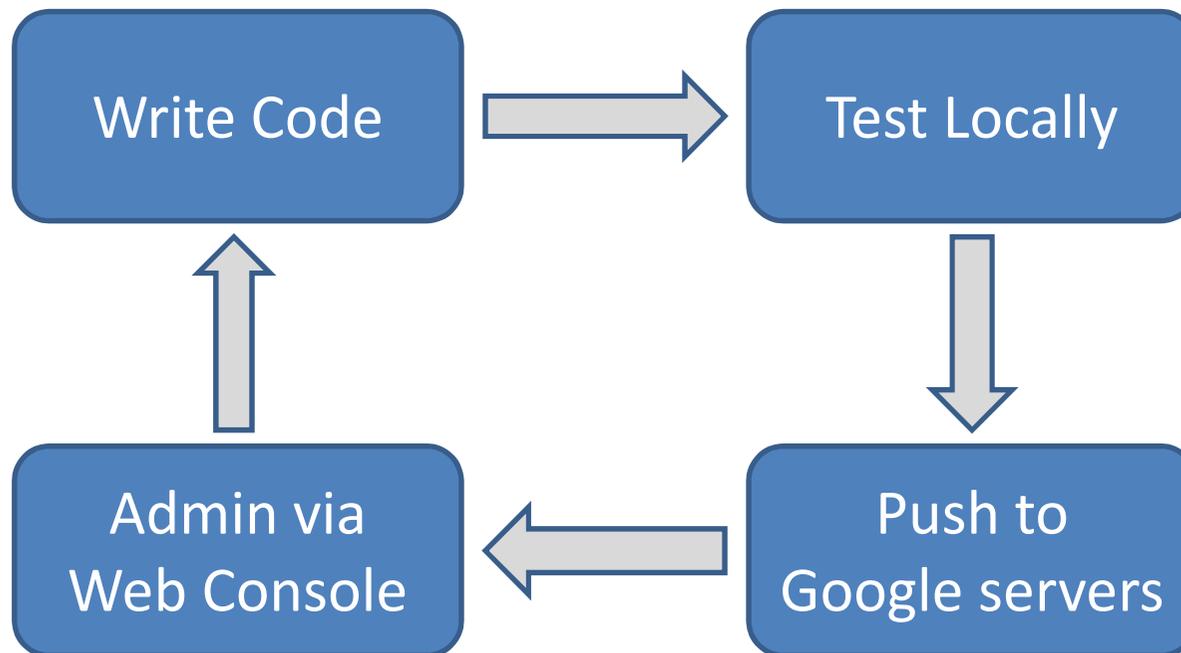
App Engine Characteristics

- **Persistent storage** with queries, sorting, and transactions
- App Engine distributes user requests across multiple servers and **scales servers** to meet **dynamic traffic** demands
- **Asynchronous task queues** for performing work outside the scope of a request
- **Scheduled tasks** for triggering events at specified times or regular intervals
- **Integration** with all other Google Cloud services and APIs
- Your application runs within its own **secure, sandboxed and reliable** environment
  - Independent of the hardware, operating system, or physical location of the server

Use Cases

- **Rovio**
  - Transition "Angry Birds" games to an online environment
  - Use a platform that could support explosive demand
  - Easily add new features to improve the user experience

- **Ubisoft**
  - Develop a web-based version of a console game "From Dust"
  - Find an easy-to-use system so developers focus on the user experience
  - Scale effortlessly to accommodate a fast-growing number of players

- **Best Buy**
  - Quickly develop and deploy apps to achieve its business goals
  - Create apps that are scalable and low-maintenance
  - Dramatic time and cost savings in app development, which has led to the creation of many more apps

Services of Relevance for App Engine

- **Google Cloud SQL** - A fully-managed web service that allows you to create, configure, and use relational databases in Google's cloud

- **Datastore** - A schemaless object datastore providing robust, scalable storage for your web application, a rich data modeling API, and a SQL-like query language called GQL

- **Blobstore** - Allows your application to serve large data objects, such as video or image files, that are too large for storage in the Datastore service

Other data services

- **Search** - Allows your application to perform Google-like searches over structured data such as: plain text, HTML, atom, numbers, dates, and geographic locations.

- **Memcache** - A distributed, in-memory data cache to improve application performance

- **Logs** - Provides programmatic access to application and request logs from within your application

Communication

- **Channel** - Creates a persistent connection between your application in Google servers and JavaScript clients so you can send messages to clients in real time without "polling"

- **Mail** - Sends email messages on behalf of administrators and users with Google Accounts, and receives mail at various addresses

- **XMPP** - Enables an application to send and receive chat messages to and from any XMPP-compatible chat messaging service

- **Traffic Splitting** - Allows you to roll out features for your app slowly over a period of time. Traffic Splitting works by splitting incoming requests to different versions of your app

Process management

- **Task Queue** - Allows applications to perform work outside of a user request, and organize that work into small, discrete units, called "tasks," to be executed later

- **Scheduled Tasks** - Allows applications to configure regularly scheduled tasks that operate at defined times or regular intervals

- **Remote** - Lets external applications transparently access App Engine services. For example, you can use Remote API to access a production datastore from an app running on your local machine.

Other services

- **App Identity** - Gives code access to the application identity; provides framework to assert this identity over OAuth.
- **Users** - Allows applications to sign in users with Google Accounts or OpenID, and address these users with unique identifiers.
- **Capabilities** - Provides detection of outages and scheduled maintenance for specific APIs and services, so that your application may bypass them or inform your users.
- **Multitenancy** - Makes it easy to compartmentalize your data to serve many client organizations from a single instance of your application.
- **PageSpeed** - A family of tools that automatically optimizes the performance of your application.

IaaS Pricing Model

- Per instance hour

- Per storage amount/month

- Per Network bandwidth/month

- Per additional services

  - Static IP

  - Autoscaling/load balancing

PaaS Pricing Model

	FREE *LIMIT PER DAY*	PRICE *ABOVE FREE LIMIT*
Instances	28 instance hours	$0.05 / instance / hour
Cloud Datastore *(NoSQL)*	• 50k read/write/small • 1 GB storage	• $0.06 / 100k read or write ops • Small operations free* • $0.18 / GB / month
Network Traffic *(Outgoing)*	1 GB	$0.12 / GB
Network Traffic *(Incoming)*	1 GB	FREE
Cloud Storage	5 GB	$0.026 / GB / month
Memcache	• Free Usage of Shared Pool • No free quota for Dedicated Pool	• Free Usage of Shared Pool • Dedicated Pool: $0.06 / GB / hour

Data taken in 2016
https://cloud.google.com/products/calculator/

PaaS Pricing Model

	FREE LIMIT PER DAY	PRICE ABOVE FREE LIMIT
Search	• 1000 basic operations • 0.01 GB indexing documents • 0.25 GB document storage • 100 searches	• 0.50 / 10k searches • 2.00 / GB indexing documents • 0.18 / GB / month Storage
Email API	100 recipients	Contact Sales
Logs API	100 MB	$0.12 per GB
Task Queue	5 GB	$0.026 / GB / month
Logs Storage	1 GB	$0.026 / GB / month
SSL Virtual IPs	-	$39 / virtual IP / month
Bundled Services	Cron, Image Manipulation, SNI SSL Certificates, Socket API, Task Queue API, URLFetch, Users API	

Windows Azure

- Hybrid PaaS & IaaS cloud platform

- Designed more for enterprise applications

- Programming languages
  - .NET, Java, PHP, Node.js, Python, or Ruby

- Datastores
  - Azure SQL database and NoSQL storage

https://azure.microsoft.com/

Windows Azure

- BigCompute
  - HPC on demand
  - MPI applications with Remote Direct Memory Access (RDMA)
- HDInsight
  - Setting up dynamic Hadoop clusters for Data Analysis
- Examples of applications running in Azure:
  - Office 365, Skype, Bing, and Xbox
  - WebZen, Toyota Gazoo.com, HALO

AWS Elastic Beanstalk

- Languages: Java, .NET, PHP, Node.js, Python, Ruby, Go

- Platforms: Docker, Apache, Nginx, Passenger, and IIS

- Automatically handles deployment, capacity provisioning, load balancing, auto-scaling, application health monitoring

- More manual control available (and required)

https://aws.amazon.com/elasticbeanstalk/

Other PaaS Examples

- AppScale https://www.appscale.com/
  - Open-Source framework
  - Supports Google App Engine Applications
  - Supports MySQL Clusters, HBase, Hypertable, and Apache Cassandra
  - Python, Go, and Java applications
- Cloud Foundry https://www.cloudfoundry.org/
  - open-source PaaS platform that supports programming languages Java and Scala
- AppFog https://www.ctl.io/appfog/
  - Supports Java, Node, .Net, Ruby, PHP, MySQL, Mongo, PostgreSQL
  - Choose your own Cloud Provider.
- Heroku: Cloud Application Platform https://www.heroku.com/
  - Was one of the first PaaS services offered on the market
  - Supports Ruby, Java, Scala, and Python applications

PaaS Advantages

- User does not have to manage low level computing resources and services
- Many services ready to use in a plug-in fashion without any configuration or setup
- **Provider handles most of the non functional requirements of your applications**
- **Scaling is automatically managed** by the platform
- Easier and Agile application deployment
  - Simplifies prototyping and application startups
- **Lower costs**
  - Pay for only what is used
  - More fine-grained cost model than in IaaS
- Platform provider has the best knowledge to optimize the services running on the underlying hardware

PaaS Disadvantages

- **Not in full control** over:
  - Computing resources (Intel vs AMD, GPU's, FPGA, …)
  - Software and library versions
  - Service configuration
- Available programming languages are often limited
- **Vendor lock-in**
- Offered services may not be flexible enough for user needs
- Have to **fully trust** in the PaaS provider
  - Billing accuracy
  - Security
  - Reliability
  - Data ownership
- What happens when application exceeds billing quotas? What happens when payments fail?

That's All

- This weeks practice session is:
  - Creating and deploying Google App Engine applications using python

- Next lecture
  - Other Cloud Services & Cloud based research at Mobile & Cloud Lab

References

- Mastering Cloud Computing: Foundations and Applications Programming

Authors: Rajkumar Buyya, Christian Vecchiola, S.Thamarai Selvi

- Google Cloud Platform https://cloud.google.com/
- Chakkrit Tantithamthavorn, Introduction to Google App Engine, https://www.slideshare.net/klainfo/introduction-to-google-app-engine-13223789

AppEngine for Mobiles

- Define business logic on App Engine and access them via RESTful APIs on multiple platforms including Android, IOS and JavaScript.

- Deploy an app in 300 seconds

- Automatically generate strongly-typed client libraries for iOS, Android, and JavaScript.

- Geo-proximity search

- Push Notifications to iOS and Android

- Simple access to data storage and processing

AppEngine for Mobiles

iOS

Cloud Endpoint Clients

Mobile Backend Running On
Google App Engine Instances
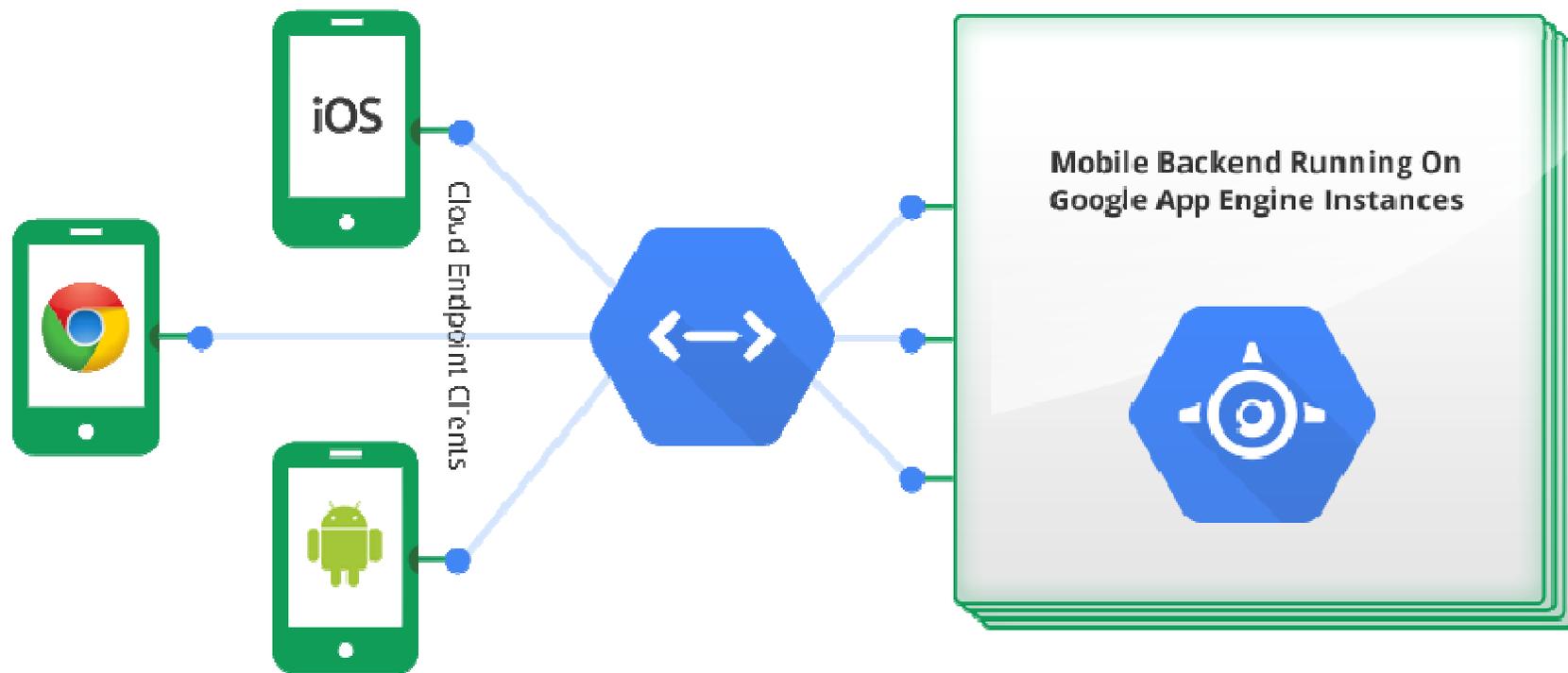
Mobile Gaming on the Google Cloud Platform – Solution Reference Architecture Diagram