# Programming Abstractions in Cloud

## *Shashikant Ilager*

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https://eduassistpro.github.io/

*Vie*        *ustria*

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*Email: shashikantilag*

*Website: shashikantilager.com*

# Outline

- Cloud Computing
  - Computing as a utility
- Programming network
  - TCP ports and sockets
  - RPC
- Cloud Application Platforms
  - Platform as a Service (PaaS)
- Aneka: A Cloud Middle-ware Platform
- Summary

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# Cloud Computing

- Outsource IT facilities to cloud providers
- Avoid expensive up-front investments
- Computing as a utility (like electricity, water, etc..)
- On-demand
- Pay for what you use
- Virtualized resources

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# Programming Networked Computers

- Sockets
  - Most familiar communication way for networked applications
  - Enables applications to interact with transport layer
  - Bound to a local port
  - IP address + port = Soc
  - Socket can be used for sending and re
  - Acts as a programming interface to application code and transport layer
  - Each socket is associated with a protocol (UDP or TCP)

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# Programming Networked Computers

- Transmission Control Protocol (TCP)

  - Connection Oriented

  - Provides an abstr ... ream (called as packets).
  - Stream provide t ... onsumer communication.

  - Data sent by the producer are queued until the consumer is ready to receive them.
  - Example use cases – http, ftp

  - TCP Socket Programming Demo

# Programming Networked Computers

- Socket handling becomes complex when applications scale to large number of servers

  - Typical application in cloud spans from few hundred to thousands of servers

  - Individual port to each

  - Read write buffers

  - Synchronization

  - Exception handling

  - All of the above functionalities within application makes developing application costly and erroneous

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# Programming Networked Computers

- Remote Procedure Call (RPC)
  - RPCs enable clients to execute procedures in server processes based on a defined service interface (Procedural languages: C, Fortran, GO)

  - Remote Method Invocati                              nguages (JAVA)

  - Higher abstraction than sockets

- Key components of RPC:

  - Communication Module
  - Client Stub Procedure
  - Dispatcher
  - Server stub procedure

# Programming Networked Computers

- RPC/ RMI is useful in simple applications where resources are usually static in nature (mostly worked during cluster/Grid computing era).

- Cloud applications are dynamic that requires:

  - Elasticity – On demand provision
  - Monitoring – Heartbeat,
  - Robustness – Availability, Failure manage

- Middleware that seamlessly manages dynamic resources and handles runtime network communication is necessary.

# Cloud Application Platforms

- Cloud Application Platforms (CAP) provide highest level of abstractions to build the applications

- Abstraction through SDKs, APIs and middle-ware platforms

- Less efforts on resourc~~~ ~~are focus on application

- Examples include
  - Google App Engine
    - Deploy web applications on the fly
  - Microsoft Azure PaaS platforms
    - Highly suitable platform for enterprise application developments
  - Aneka (Manjrasoft, CLOUDS Lab, UniMelb)
    - Cloud application platform with multiple programming models

# Aneka: Cloud Application Platform(CAP) for Resource-Intensive/Elastic Apps

- Platform supporting multiple Cloud programming models (Task, Thread, MapReduce)
- **SDK (Software Development Kit)** containing APIs for multiple programming models and tools
- **Runtime** Environment for managing application execution on Clouds
- Suitable for
  - Development of Enterprise Cloud Applications
  - Cloud enabling legacy applications
- Portability for Customer Apps:
  - Enterprise ⬌ Public Clouds
  - .NET/Win ⬌ Mono/Linux

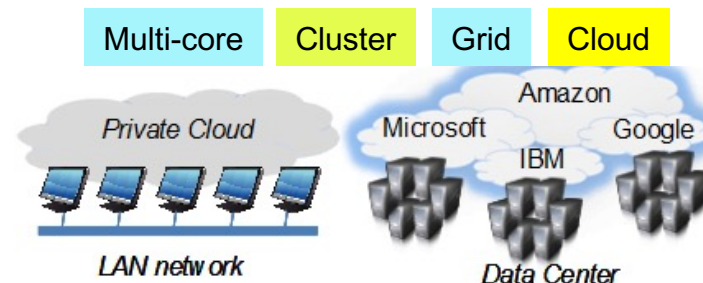**Multiple Applications**

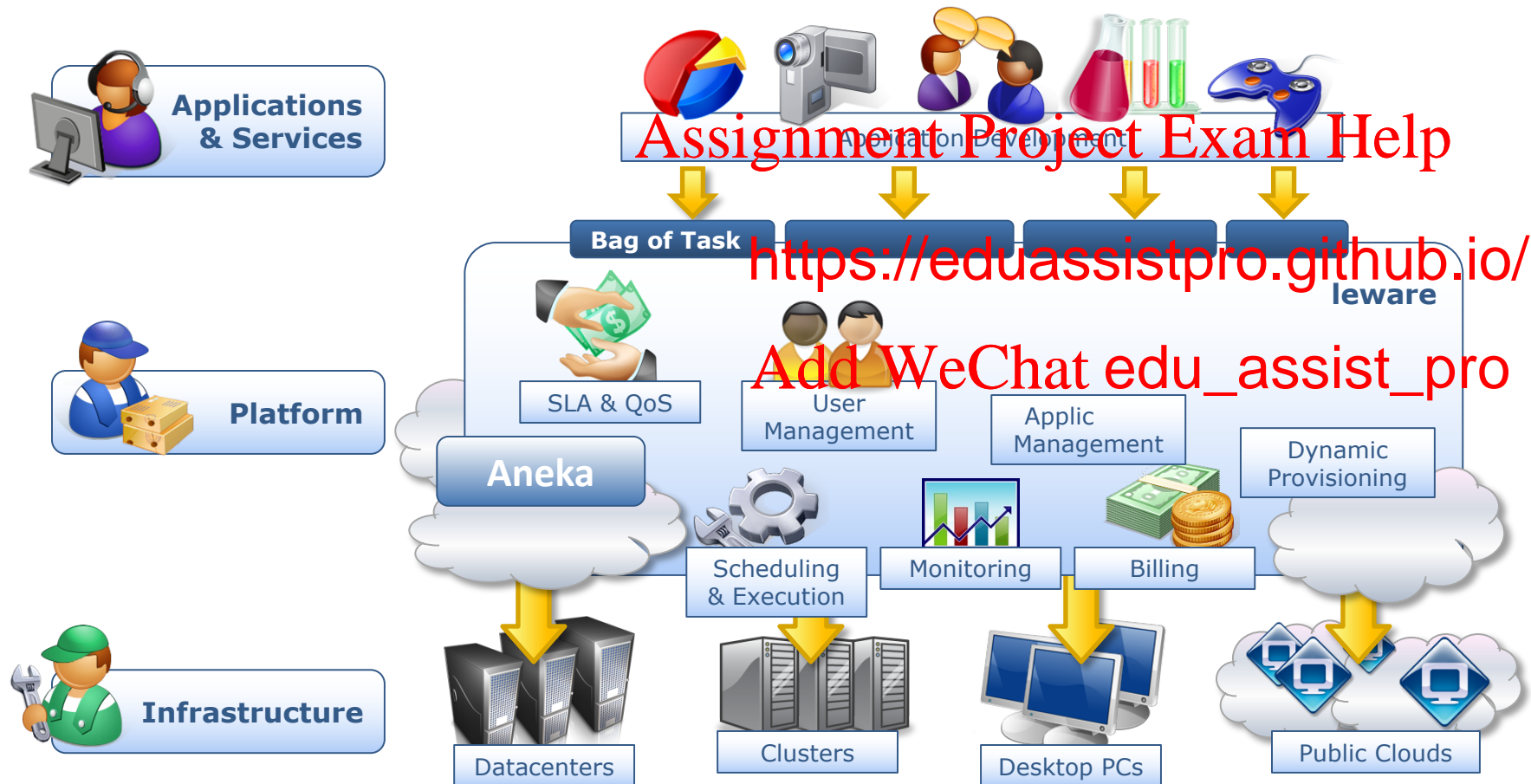| Thread | Task | ... | MapReduce |

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**1. SDK**

**2. Runtime**

| Multi-core | Cluster | Grid | Cloud |



**Multiple Infrastructures**

# Aneka as a Cloud Application Platform

# Aneka as a Cloud Application Platform

- Aneka Demo

# Summary

- Cloud Application Platforms like Aneka simplifies the process of building large scale distributed systems

- Although middle-ware platforms provide abstraction to programmer, the underl ns are still need to be implemented s.

- Acquiring skills to build such tools and is crucial.

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# Thank You

**Questions?**

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For any queries, please contact me at: shashikant.ilager@tuwien.ac.at