Programming Abstractions in Cloud

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Outline

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

Cloud Computing

- Outsource IT facilities to cloud providers
- Avoid expensive up-front investments
- Computing as a utility
- On-demand
- Pay for what they use
- Virtualized resources

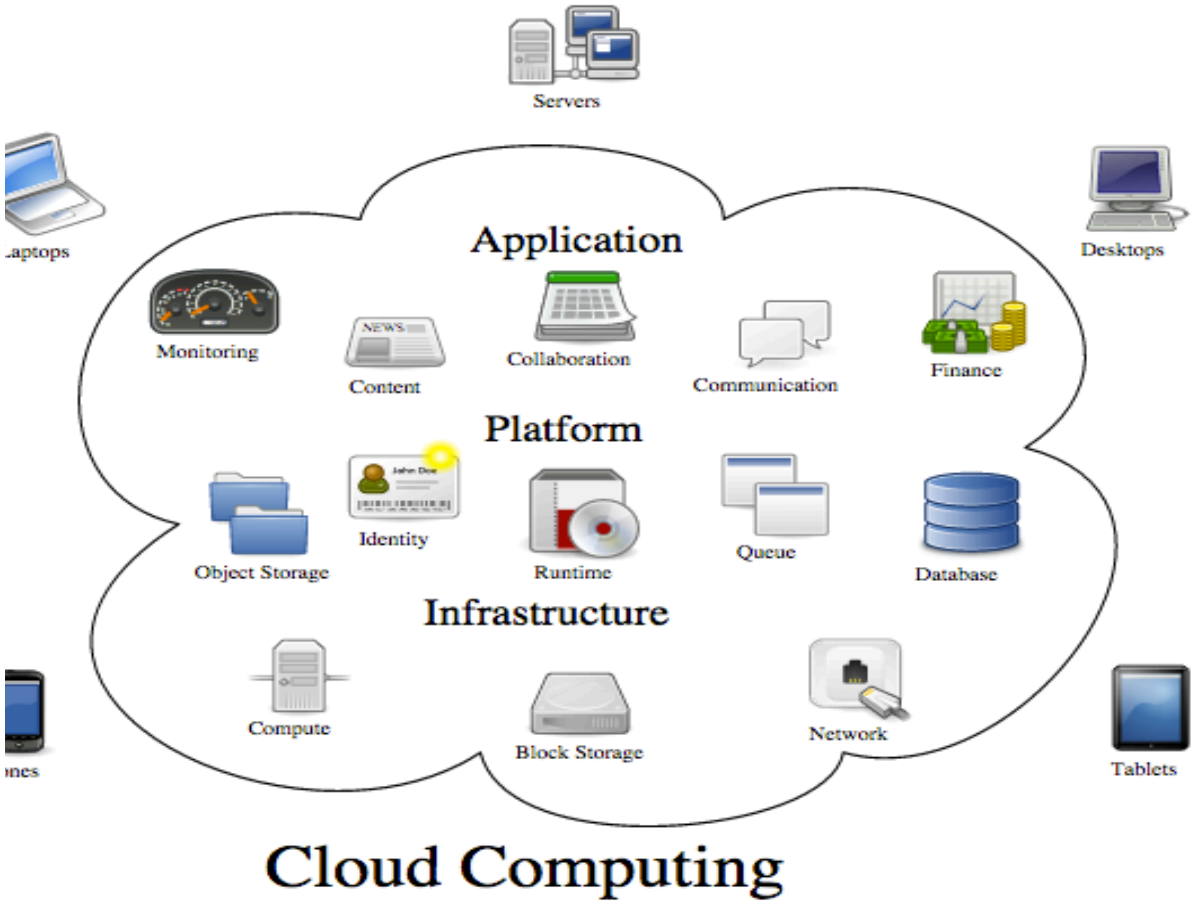


Figure: http://en.wikipedia.org/wiki/Cloud_computing

Programming Networked Computers

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

Programming Networked Computers

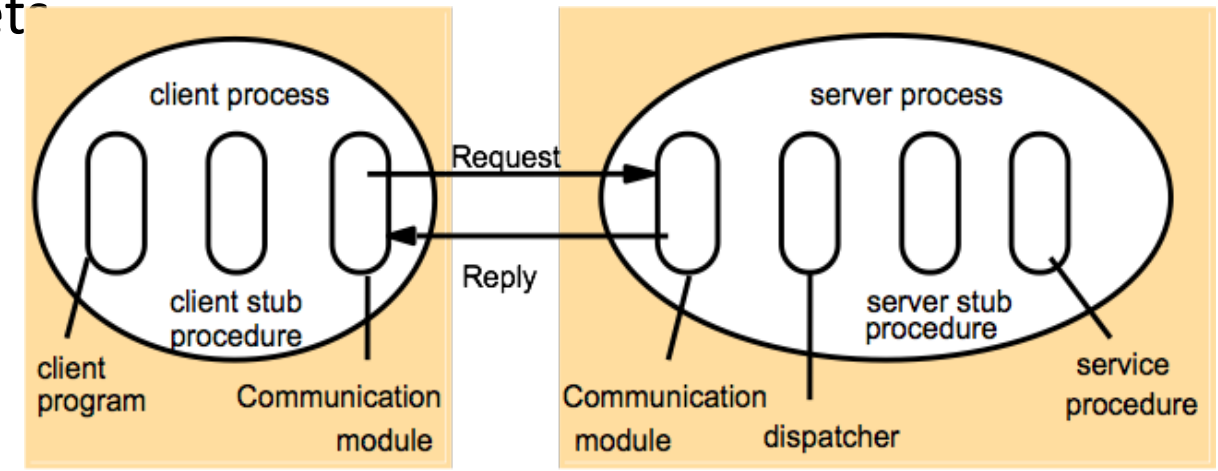
- Transmission Control Protocol (TCP)
  - Connection Oriented
  - Provides an abstraction for a two-way stream (called as packets).
  - Streams do not have message boundaries.
  - Stream provide the basis for producer/consumer communication.
  - Data sent by the producer are queued until the consumer 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 server
  - Read write buffers
  - Synchronization
  - Exception handling

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 Invocation (RMI) for Object Oriented languages (JAVA, C#)
  - Higher abstraction than socket
- Key components of RPC:
  - Communication Module
  - Client Stub Procedure
  - Dispatcher
  - Server stub procedure



Programming Networked Computers

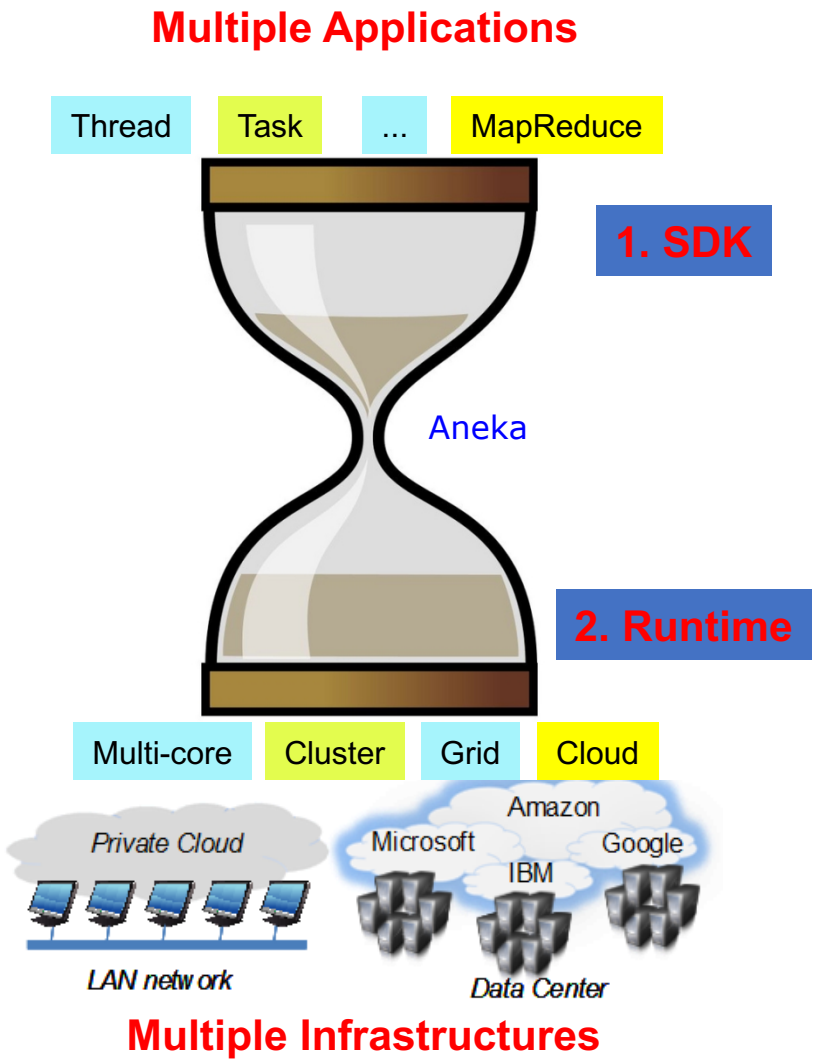
- RPC/ RMI is useful in simple applications where resources are usually static in nature.
- Cloud applications are dynamic that requires:
  - Elasticity – On demand resource provision and de-provision
  - Monitoring – Heartbeat, Budget Constraints, etc.
  - Robustness – Availability, Failure management
- Middleware that seamlessly manages dynamic resources and handles runtime network communication is necessary.

Cloud Application Platforms

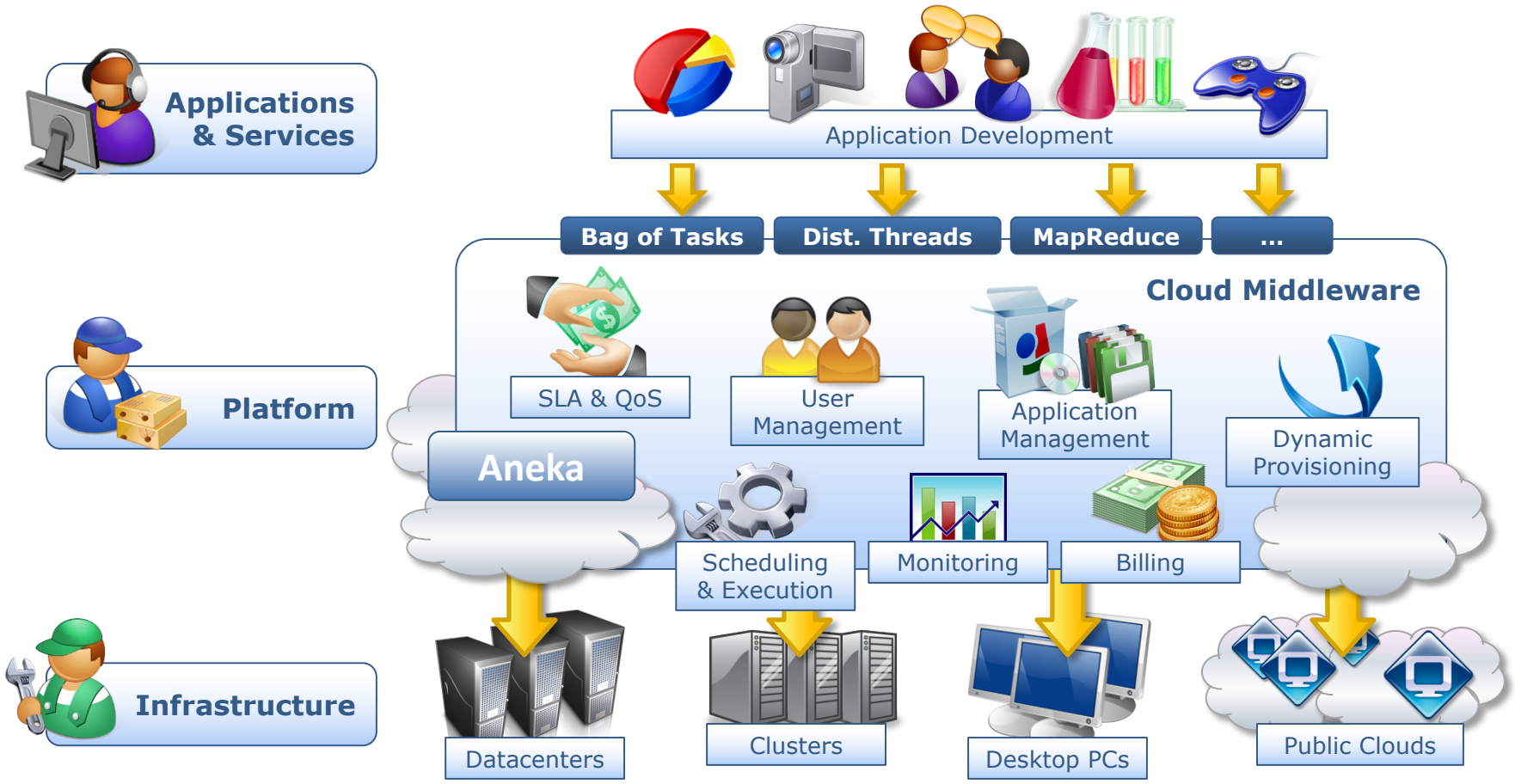
- Cloud Application Platforms (CAP) provide highest level of abstractions to build the applications
- Abstraction through SDKs, APIs and middle-ware platforms
- Less efforts on resource management and more focus on application
- Examples include
  - Google App Engine
    - Deploy web applications on 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



Aneka as a Cloud Application Platform



Aneka as a Cloud Application Platform

- Aneka Demo

Summary

- Cloud Platforms like Aneka simplifies the process to build the applications.
- Although middle-ware platforms provide abstraction to programmer, the underlying complex operations are still need to be implemented inside the platforms.
- Acquiring skills to build applications in such platforms is crucial.

Questions?

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