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Cloud Systems and Infrastructures II

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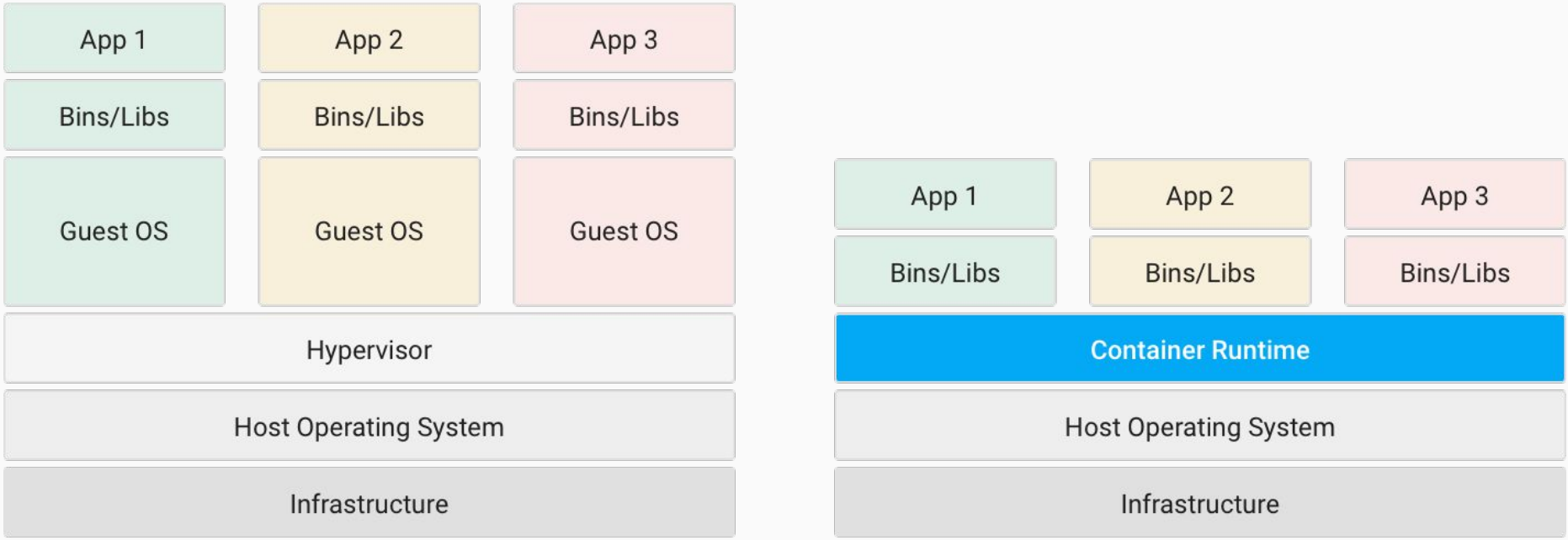
Agenda

- Containers
- Cloud Functions/Run
- API and Communication

Containers

Containers is an abstraction of the application packing and it allows the application to decouple with the running environment.

Containers


App 1
App 2
App 3
Bins/Libs
Bins/Libs
Bins/Libs
Guest OS
Guest OS
Guest OS
Hypervisor
Host Operating System
Infrastructure
Virtual Machines
App 1
App 2
App 3
Bins/Libs
Bins/Libs
Bins/Libs
Container Runtime
Host Operating System
Infrastructure
Containers

Containers

Containers benefits:

- Easy deployment / low operational burden
- Isolation between applications
- Less resource usage for small applications
- Easy migration
- Multi-Cloud / Hybrid-Cloud Support

Kubernetes Components:

- Master Components: Control Plane
  - Control Plane vs Data Plane
- Node Components: Running Environment
- Addons: Monitoring and Tooling

Containers

Kubernetes Concepts:

- Images
- Images Registry
- Nodes
- Pods
- Deployments

Cloud Functions

Cloud Functions is a event-driven computing services for lightweight computational tasks.

Cloud Functions could be very useful in developing event-driven workload such as data pipelines, IoT backends or machine learning data processors.

Small Demo: Create a Cloud Functions function.

API and Communication

Generally, an application programming interface (API) is a set of subroutine definitions, communication protocols, and tools for building software. [1]

- Definitions: written in a configuration language. (yaml, proto3)
- Communication Protocols: HTTP, pubsub, CORBA
- Tools for building software: usually in the form of production-quality SDK

API and Communication

gRPC is an open source RPC framework which offers high-performance configurable API implementation and multi-language support.

- proto as message definition language
- support Streaming and RESTFul API
- rich tooling with multi-language support

Demo: Create a Restful API with gRPC

Practice: Create your own API with gRPC.

To generate gRPC code:

```
python -m pip install grpcio
python -m grpc_tools.protoc -I.
--grpc_python_out=. --python_out=plugins=grpc:.
student.proto
```

API and Communication

Student.proto

```
syntax = "proto3";

// The student profile service definition.
service StudentService {
  // Returns a student resource.
  rpc GetStudent (GetStudentRequest) returns (Student) {}
}

// The request message containing the user's hunter ID.
message GetStudentRequest {
  int32 id = 1;
}

// Student resource message.
message Student {
  int32 id = 1;
  string name = 2;
}
```

API and Communication

client.py

```
import sys
import grpc

import student_pb2
import student_pb2_grpc


def main(id):
  with grpc.insecure_channel('localhost:50051') as channel:
    stub = student_pb2_grpc.StudentServiceStub(channel)
    response = stub.GetStudent(student_pb2.GetStudentRequest(id=id))
    print(response.name)


if __name__ == '__main__':
  main(int(sys.argv[1]))
```

API and Communication

server.py

```
from concurrent import futures
import time
import grpc

import student_pb2
import student_pb2_grpc

_HUNTER_STUDENTS_ = {1:"STU1", 2:"STU2",3:"STU3"}

class StudentService(student_pb2_grpc.StudentServiceServicer):

  def GetStudent(self, request, context):
    return student_pb2.Student(id=request.id, name=_HUNTER_STUDENTS_[request.id])
```

API and Communication

Server.py (continued)

```
def serve():
  server = grpc.server(futures.ThreadPoolExecutor(max_workers=10))
  student_pb2_grpc.add_StudentServiceServicer_to_server(StudentService(), server)
  server.add_insecure_port('[::]:50051')
  server.start()
  try:
    while True:
      time.sleep(60*60) # 1 hour
  except KeyboardInterrupt:
    server.stop(0)


if __name__ == '__main__':
  serve()
```

Readings

Borg, Omega, and Kubernetes. Google Research. *https://static.googleusercontent.com/media/research.google.com/en//pubs/archive/44843.pdf*

One of the following two:

- *Google's API design guide. https://cloud.google.com/apis/design/*
- *Microsoft's API design guidance. https://docs.microsoft.com/en-us/azure/architecture/best-practices/api-design*