Platform as a Service (PaaS)

COSC349—Cloud Computing Architecture

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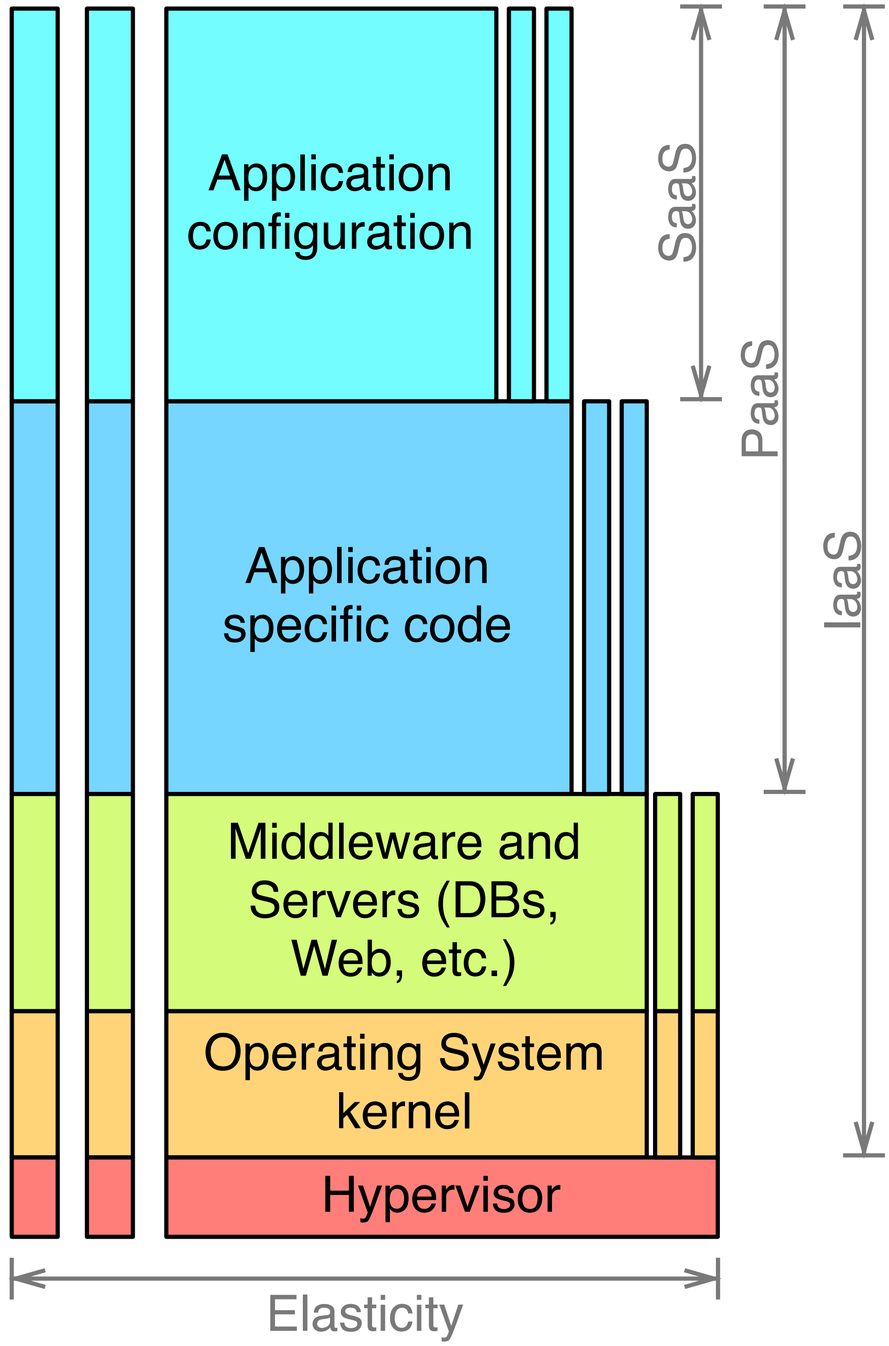
Learning objectives

- Define **Platform as a Service** (PaaS)
- Contrast **PaaS** with **IaaS** (and eventually with SaaS)
- Indicate good and bad points about PaaS
- Sketch how an application might be **deployed** using a given PaaS platform
- Explain how Docker and other **container technology** has affected PaaS offerings

PaaS—Platform as a Service

- PaaS is between IaaS & SaaS
  - You don't manage VMs directly (IaaS)
  - Can't just use app. software (SaaS)
  - Aimed at **use by software developers**
- Term 'platform': broad & imprecise
- Key point: cloud provider will see **your software components**



Benefits and disadvantages of PaaS

- Focus on **your application logic**, not managing VMs
  - Just get the cloud environment, such as APIs to work with
  - Cloud provider can further **leverage economies of scale**

- Disadvantages: potentially **get lock-in**
  - More likely API is tied to specific software from cloud provider
    - Although mature interchange languages like SQL mitigate this
  - **Lack of flexibility**: public PaaS isn't necessarily very extensible
    - Also don't have complete control over the cloud's services

PaaS examples emerged soon after IaaS

- **Heroku** (since 2007) provided cloud hosting of Ruby
  - PaaS: you just upload Ruby source code; app gets deployed
  - Like many PaaS offerings, it is hosted on Amazon EC2 (IaaS)
- **Google App Engine** (2008)
  - Google already had scalable APIs for their own software
  - App Engine was a way to turn that into a service for sale
- **RedHat OpenShift** (2011)—closed then open source…
  - Sought to effect paradigm shift: scalable components (v2)
- **VMware Cloud Foundry** (2011)—always open source

Heroku

- Ruby on Rails (2004) promoted Ruby for web coding
  - popularised model-view-controller; usually web+database
  - HTTP-focused web accessibility (*e.g.*, web and **REST**)

- Deploying code to Heroku typically **done using git push**
  - Other deployment methods added: *e.g.*, **Dropbox**, and an **API**

- Language-focused clouds **don't have to be Ruby**
  - Now also Node.js, Clojure, Scala, PHP, Python, Go, Java, …

Google App Engine (GAE)

- Lots of development language options:
  - *e.g.*, Java, Python, Go, PHP, Node.js, …
  - Overall makes coding easy, but limited in form
- Code can only **react to HTTP requests** (can self-request)
- Database provided: originally Google's **Cloud SQL**
- Lock-in concerns mitigated (?) by FOSS AppScale, *etc.*

FYI—RedHat OpenShift v1 and v2

- Applications used ‘gears’ to do their computing
  - Gears used namespaces, cgroups and SELinux for isolation
  - Free-tier allowed three non-scalable gears (until platform EOL)
    - I hosted a test Drupal website and an Etherpad server…
- Notion of ‘cartridges’ that can be combined in a gear
  - Language cartridges such as Ruby on Rails
  - Database cartridges such as MySQL or MongoDB
- Cartridges auto-interconnected, *e.g.*, Rails + MySQL

FYI—RedHat OpenShift version 3

- Gears turned into **Docker containers**
- Orchestration of containers uses **Kubernetes**
  - OpenShift 2 had a custom broker to manage multi-gear apps
- Images are mapped 1:1 to containers
  - OpenShift 2 cartridges could be loaded N:1 into a gear
- OpenShift 3 uses images like any other Docker client
  - OpenShift 2 required a code repository within OpenShift itself

Cloud Foundry

- Started within VMware—**open source** throughout
  - Targets multiple execution platforms
    - *e.g.*, private clusters running VMware vSphere, OpenStack
    - All the IaaS cloud providers we've discussed

- Cloud Foundry supports software '**lifecycles**'
  - Buildpack lifecycle: Java; JavaScript; Ruby; Python; PHP; Go; notably adds .NET and .NET Core
  - Docker containers can be run in a different type of lifecycle

PaaS and (software) containers?

- Containers rose to prominence after PaaS began
- **Amazon ECS** provides two container solutions
  - **EC2 launch type** can help manage a cluster of VMs
    - Essentially is assisted IaaS: you specify container server EC2 types
  - **Amazon Fargate type** accepts container images directly
    - No management of underlying VMs, thus much more PaaS-like
- **Google Kubernetes Engine**
  - Uses Google Compute Engine nodes as workers

Typical services provided by PaaS

- **Language** runtime
  - Possibly as a framework, *e.g.*, rake rather than just Ruby
- **Database**—your PL usually doesn't include a DB
- **Load balancing** and **autoscaling** layer

- While AWS is IaaS-focused, it provides many PaaS tools
  - Elastic Load Balancer works with HTTP and other protocols
  - Amazon Relational Database Service (RDS)
  - Offerings like Elastic MapReduce (EMR)—managed Hadoop

AWS & relational databases: three variants

- (Amazon provides many non-relational databases too)
- A: allocate an **EC2 instance** and install a database
  - You can install whatever you want …
    - but patching, scaling and backup/restore are your problem
- B: **Amazon Relational Database Service** (RDS)
  - Choose: PostgreSQL, MySQL, MariaDB, Oracle, SQL Server…
    - Patching, scaling and backup/restore are Amazon's problem
- C: **Amazon Aurora**: choose PostgreSQL or MySQL

Amazon Aurora

- Amazon realised MySQL on EC2 had **too many layers**
  - MySQL tried optimising file access on disk—opaque to Amazon
  - But MySQL has pluggable datable storage engines, so…
- In Aurora, Amazon switches in their **own database engine**
  - All data has 6 replicas across 3 availability zones
  - Database is backed up continuously to S3
  - Performance+reliability boost is Amazon-specific: is this lock in?
- Amazon later reengineered PostgreSQL in a similar way