Chapter 12. Migrating to Cloud

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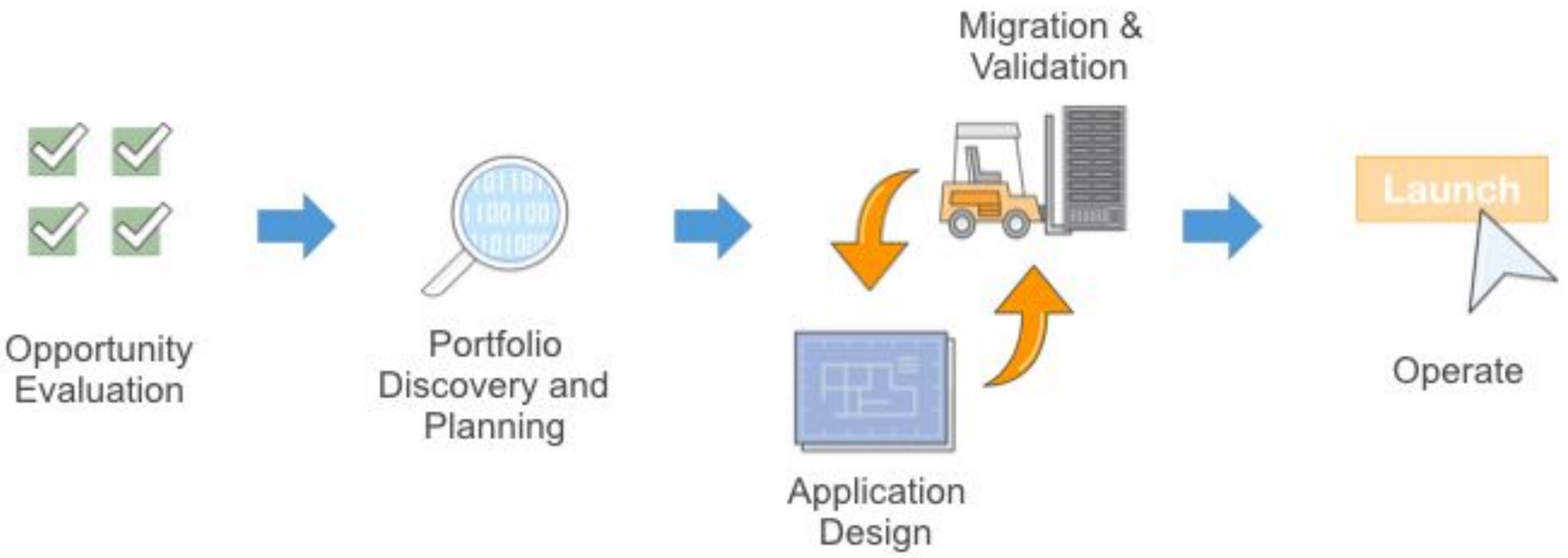
Introduction

- **Migration Process (5-phased)**



https://aws.amazon.com/blogs/enterprise-strategy/214-2/

Opportunity Evaluation

- **Cloud Business Models**
  - New applications born in the cloud but traditional products have to handle that transition
  - In general, three types of online business models
    - B2C (Business-to-Customer): Ex. Amazon retail
    - B2B (Business-to-Business): Ex. AWS & Netflix
    - C2C (Customer-to-Customer): Ex. Amazon 2nd hand bookstore
- **Use of on-prem**
  - If local computing is needed, e.g., when Internet connections are not reliable, then a “Hybrid Cloud” model is desirable with on-premise applications and data.
    - Consider: checkpointing, backup, disaster recovery, etc.

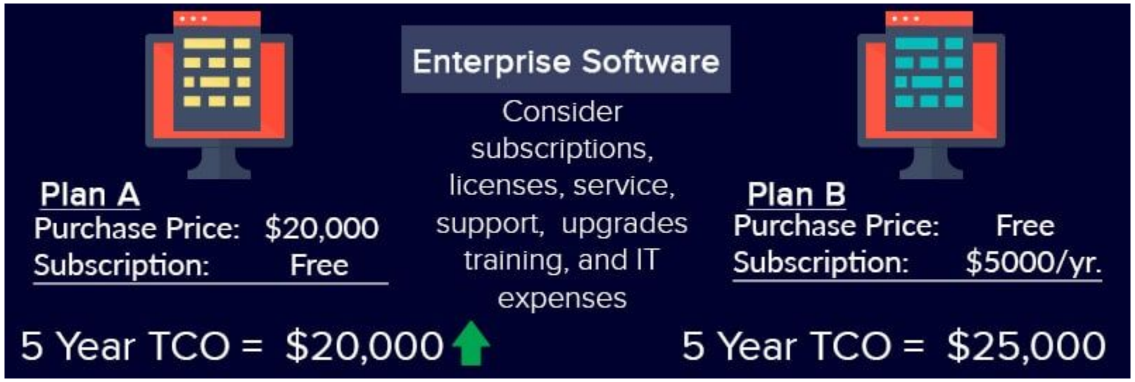
“Checkpointing” is a technique that provides fault tolerance for computing systems. It basically consists of saving a snapshot of the application's state, so that applications can restart from that point in case of failure. This is particularly important for the long running applications that are executed in the failure-prone computing systems.

Before Moving into the Cloud

- **Know your software licenses**
  - Just because you have licensing that works for you in a traditional data center does not mean you can port those licenses into the cloud
  - Different cost models
    - In general, you pay for resources by the CPU-hour in the cloud
    - Traditional software licenses are often based on the number of CPUs
  - Example
    - In a real world, you might have the following operating scenario:
      - From midnight to 9 a.m., run your application on **two application servers** for redundancy's sake
      - From 9 a.m. to 5 p.m., launch **six additional application servers** to support business-hour demand
      - For the evening hours through midnight, reduce the system down to **four application servers**
    - Adding all that up, you pay for **110 hours** of computing time with **10 application server** licenses?

Before Moving into the Cloud

- **Know your TCO (Total Cost of Ownership)**
  - Example
    - Suppose your core infrastructure is:
      - $0.01/CPU-hour: one load balancer
      - $0.04/CPU-hour: two application servers
      - $0.08/CPU-hour: two database servers
    - You would pay:
      - Daily: $0.24 + $1.92 + $3.84 = $6
      - Annual: $2,190 (not including licensing fees, management tools, or labor)
  - Use calculators of vendors (but it's not enough!)
    - https://aws.amazon.com/tco-calculator/
    - https://azure.microsoft.com/en-us/pricing/calculator/



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Before Moving into the Cloud

- **Know your location**
    - Ex: Amazon EC2 location concepts
        - Amazon EC2 is hosted in multiple locations world-wide. These locations are composed of **Regions, Availability Zones**, and **Local Zones.**
        - Resources are tied to one of them (or global)
        - Each Region (separate/independent geographic area) has multiple, isolated locations known as Availability Zones.
        - **Local Zones** provide you the ability to place resources (such as compute and storage) in multiple locations closer to your end users.
        - Resources aren't replicated across Regions unless you specifically choose to do so.
        - Failures can occur that affect the availability of instances that are in the same location. If you host all of your instances in a single location that is affected by a failure, none of your instances would be available

Resource	Type
AWS account	Global
Key pairs	Global or Regional
Amazon EC2 resource identifiers	Regional
User-supplied resource names	Regional
AMIs	Regional
Elastic IP addresses	Regional
Security groups	Regional
EBS snapshots	Regional
EBS volumes	Availability Zone
Instances	Availability Zone

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Before Moving into the Cloud

- **Know your location**
  - Ex: Amazon EC2 location concepts
    - Service (175+) → resources → locations
    - AWS deploys services regionally (regions are not equal)
    - Each **Region** is logical group of DCs and it has at least two AZs
    - An AZ consists of one or more data centers that logically treated as a single entity. All AZs in a Region are interconnected with high-bandwidth, low-latency networking
    - **Availability Zones** give us the ability to produce applications that are more highly available, fault-tolerant, and scalable
    - Unlike AZ, a **Local Zone** is not inside a Region boundary and places closer to our end-users. In order to provide a low latency communication (single-digit millisecond latency)
    - https://aws.amazon.com/about-aws/global-infrastructure/
  - You should select the right Region for your business
    - Latency (Distance to our customers)
    - Price (e.g. Tax laws or financial situations)
    - Legal restrictions (e.g. European GDPR)
    - Service availability (e.g. New services)

Cost & Billing Practices

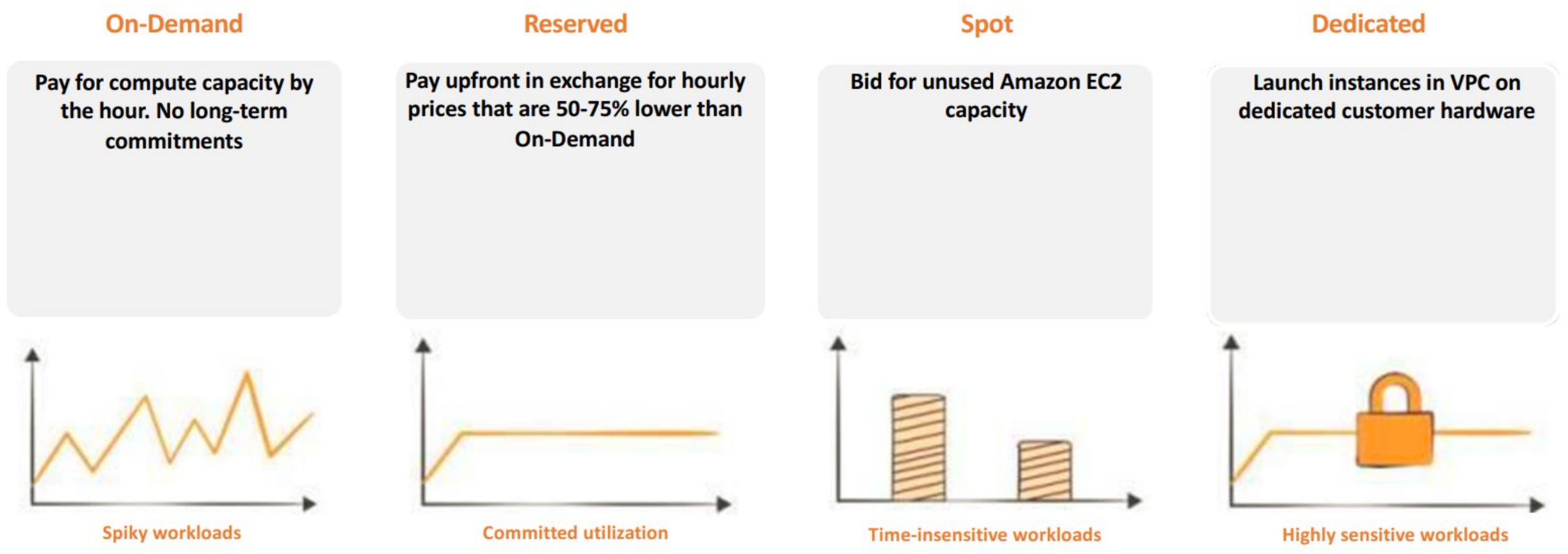
- **Pay as you go**
  - The entire Cloud Computing usage model is based on a pay as you go concept
  - This enables Cloud customers to not buy IT hardware or software products, but rent them on a time/volume basis
  - At the end of a month, or agreed upon usage period, a Cloud Service Provider (CSP) will send the bill to its users
    - If up-front menu choices are not made wisely, then the user may be in for a surprise, but little can be done retroactively to reduce costs
  - To create innovative and interesting billing propositions, major Cloud providers such as Amazon EC2 offer additional choices such as On-Demand versus Spot Instances, ability to do auto-scaling, Elastic Load Balancers,

Cost & Billing Practices

- **Ex: Amazon EC2**
  - There are no min. fees, 4 ways to pay (+Saving plans)
    - **On-demand Instances:** Customers pay for computing capacity by the hour. They can increase or decrease the computing capacity depending on the demand and only pay the specified **hourly rate** for the instances used.
    - **Spot Instances:** Amazon EC2 Spot Instances allow customers to **bid on spare** Amazon EC2 computing capacity for up to 90% off the On-Demand price. Spot **price fluctuates** based on the supply and demand of the available computing capacity. It is the leftover capacity of AWS to be used on as available basis.
    - **Reserved Instances:** Reserved Instances provide customers with a significant discount (up to 75%) compared to the On-Demand instance pricing. In addition, when Reserved Instances are assigned to a specific availability zone, they provide a capacity reservation, giving customers an ability to launch instances whenever needed.
    - **Dedicated Instances/hosts:** A dedicated instance is a virtual machine assigned to a customer and hosted on a specific host. A dedicated host is a physical EC2 server dedicated for that customer's use. No other VM will share resources with it, and resources like CPU/memory will not be shared

Cost & Billing Practices

- **Ex: Amazon EC2**



On-Demand	Reserved	Spot	Dedicated
Pay for compute capacity by the hour. No long-term commitments	Pay upfront in exchange for hourly prices that are 50-75% lower than On-Demand	Bid for unused Amazon EC2 capacity	Launch instances in VPC on dedicated customer hardware
Spiky workloads	Committed utilization	Time-insensitive workloads	Highly sensitive workloads

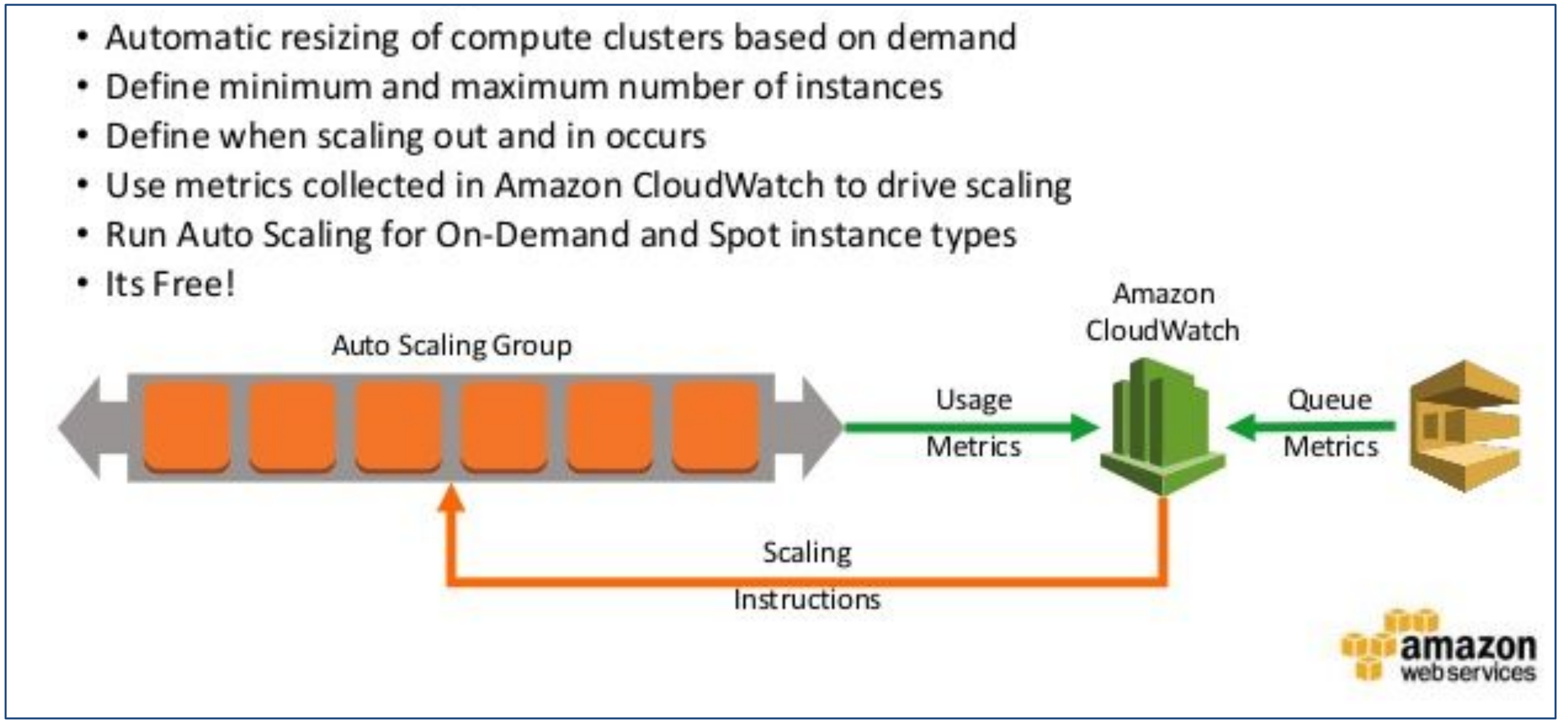
https://www.slideshare.net/shivamaan/leveraging-elastic-web-scale-computing-with-aws-64768413

Getting Traffic

- **Locating your application in an elastic env.**
    - Ex: Amazon Elastic IP (EIP)
        - When an instance is launched, AWS assigns it a public IP address. Every time the instance is stopped, this IP address is freed up. However, an application's users may expect a permanent IP address for their future sessions. AWS' solution is the use of Elastic IPs (EIPs).
        - An Elastic IP address is a static IP address designed for dynamic Cloud Computing. With an EIP, one can mask the failure of an instance or software by rapidly remapping the IP address to another instance.
        - An EIP is associated with customer's AWS account, not a particular instance, and it remains associated with the account until the customer chooses to release it.
- **Routing the incoming traffic**
    - Ex: Elastic Load Balancing (ELB)
        - ELB automatically distributes incoming application traffic across multiple Amazon EC2 instances
        - ELB ensures that only healthy Amazon EC2 instances will receive users' traffic. ELB reroutes traffic to the remaining healthy instance when required

Handling Load

- **Auto-scaling**
  - Auto-scaling is the ability of a system to Scale In or Out depending on the workload
  - Ex: Amazon auto-scaling
    - Auto scaling group (min, max, desired), launch configs, scaling plan



- Automatic resizing of compute clusters based on demand
- Define minimum and maximum number of instances
- Define when scaling out and in occurs
- Use metrics collected in Amazon CloudWatch to drive scaling
- Run Auto Scaling for On-Demand and Spot instance types
- Its Free!

https://www.slideshare.net/AmazonWebServices/day-5-aws-autoscaling-master-class-the-new-capacity-plan

Portfolio Discovery & Planning

- **Inspect**
  - What's in your environment, what are the interdependencies, what will you migrate first, and how will you migrate it?
  - That list can outline a plan on migrating each of the applications/components in your portfolio and in what order
    - The complexity of migrating existing applications varies, depending on the architecture and existing licensing arrangements
    - Any possible "quick-win"? which will give you some immediate positive reinforcement
  - There's typically less technical debt associated with something developed 3 years ago versus 20 years ago, we find a strong bias toward **rehosting** (aka "lift-and-shift"). And, because it's simply not possible to lift-and-shift a mainframe, we also find a strong bias toward feature rationalization and **re-architecting**

Application Migration

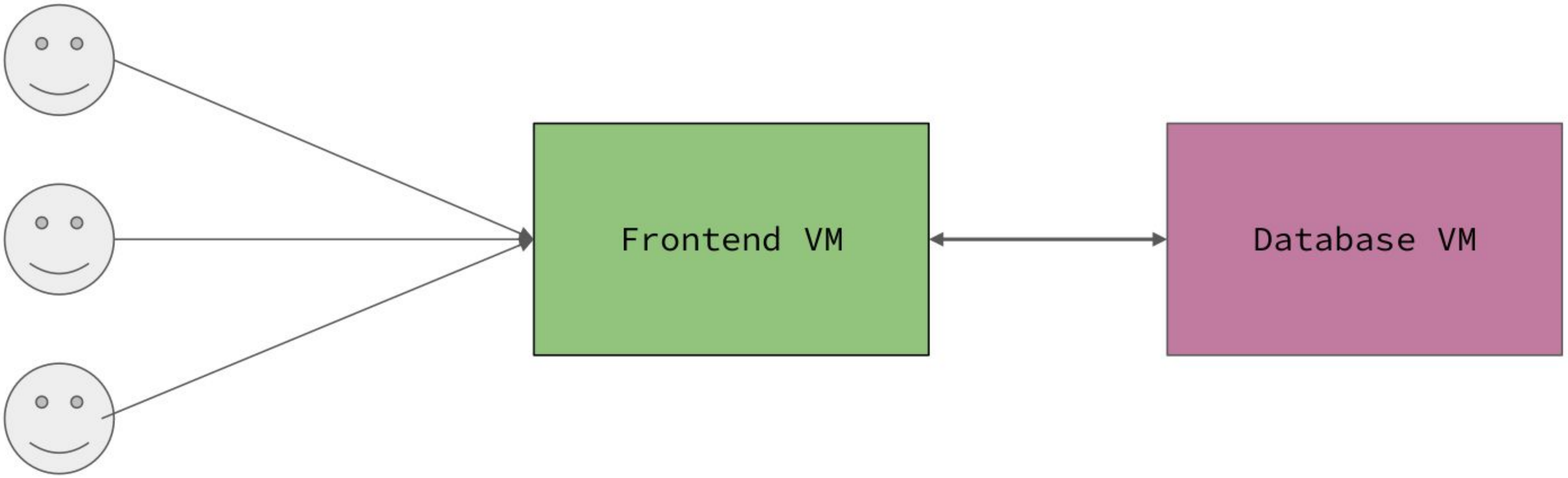
- **6 Strategies (The 6 “R”s)**
  - **1. Rehosting (lift-and-shift)**
    - Most rehosting can be automated with tools (e.g. AWS VM Import/Export, Racemi), although some customers prefer to do this manually as they learn how to apply their legacy systems to the new cloud platform.
    - Applications are easier to optimize/re-architect once they’re already running in the cloud
      - organization will have developed better skills
      - the hard part—migrating the application, data, and traffic—has already been done
  - **2. Replatforming (lift-tinker-and-shift)**
    - Here you might make a few cloud (or other) **optimizations** in order to achieve some tangible benefit, but you aren’t otherwise changing the core architecture of the application.
    - You may be looking to reduce the amount of time you spend managing database instances by migrating to a database-as-a-service platform like Amazon RDS, or migrating your application to a fully managed platform like Amazon Elastic Beanstalk

Application Migration

- **6 Strategies (The 6 "R"s)**
  - **3. Repurchasing**
    - Moving to another product (most commonly seen as a move to a SaaS platform)
      - Moving a CRM to Salesforce, an HR to Workday, a CMS to Drupal, etc.
  - **4. Refactoring / Re-architecting**
    - Re-imagining how the application is architected and developed, typically using cloud-native features
      - This is typically driven by a strong business need to add features, scale, or performance that would otherwise be difficult to achieve
      - This pattern tends to be **the most expensive**, but, if you have a good product-market fit, it **can also be the most beneficial**.
  - **5. Retire**
    - Get rid of an enterprise IT portfolio is no longer useful (simply be turned off)
  - **6. Retain (do nothing "for now")**
    - You should only migrate what makes sense for the business; and, as the gravity of your portfolio changes from on-premises to the cloud, you'll probably have fewer reasons to retain

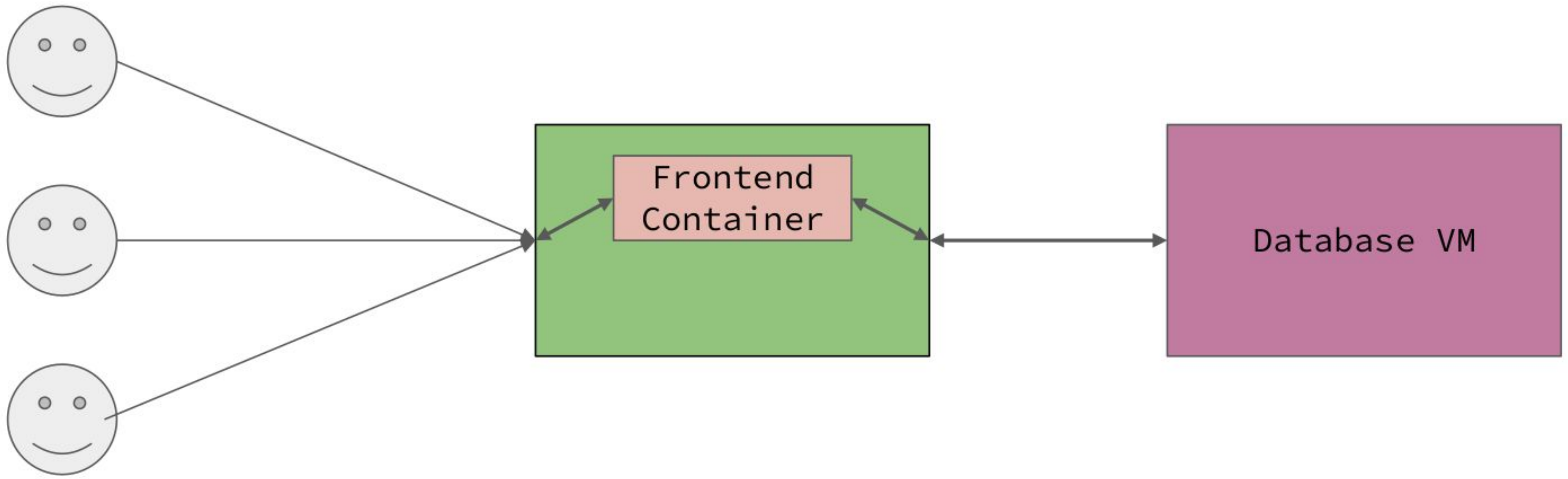
Application Migration

- **6 Strategies (The 6 “R”s)**
  - Ex: Refactor approach (v0)



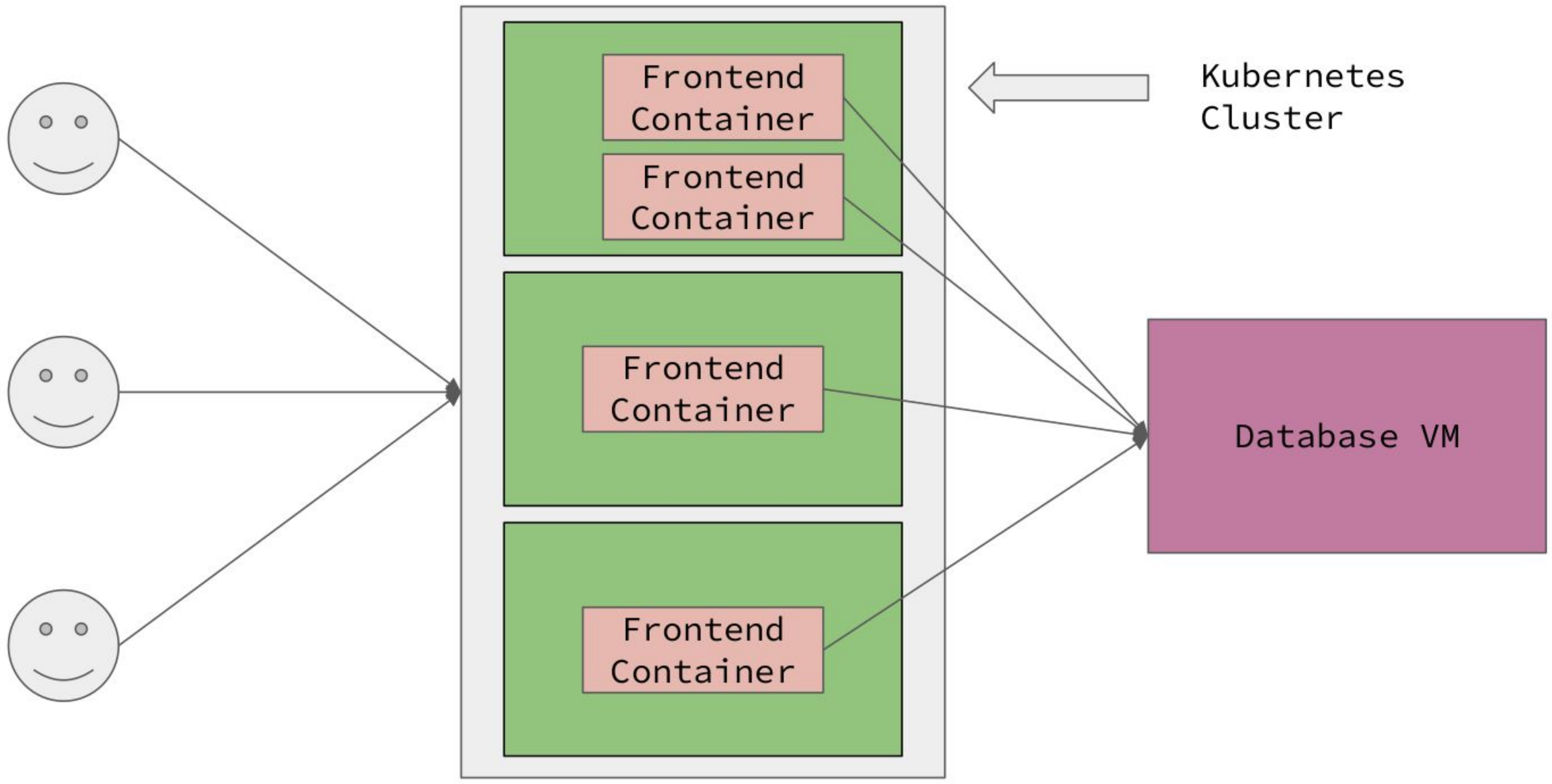
Application Migration

- **6 Strategies (The 6 "R"s)**
  - Ex: Refactor approach (v1)



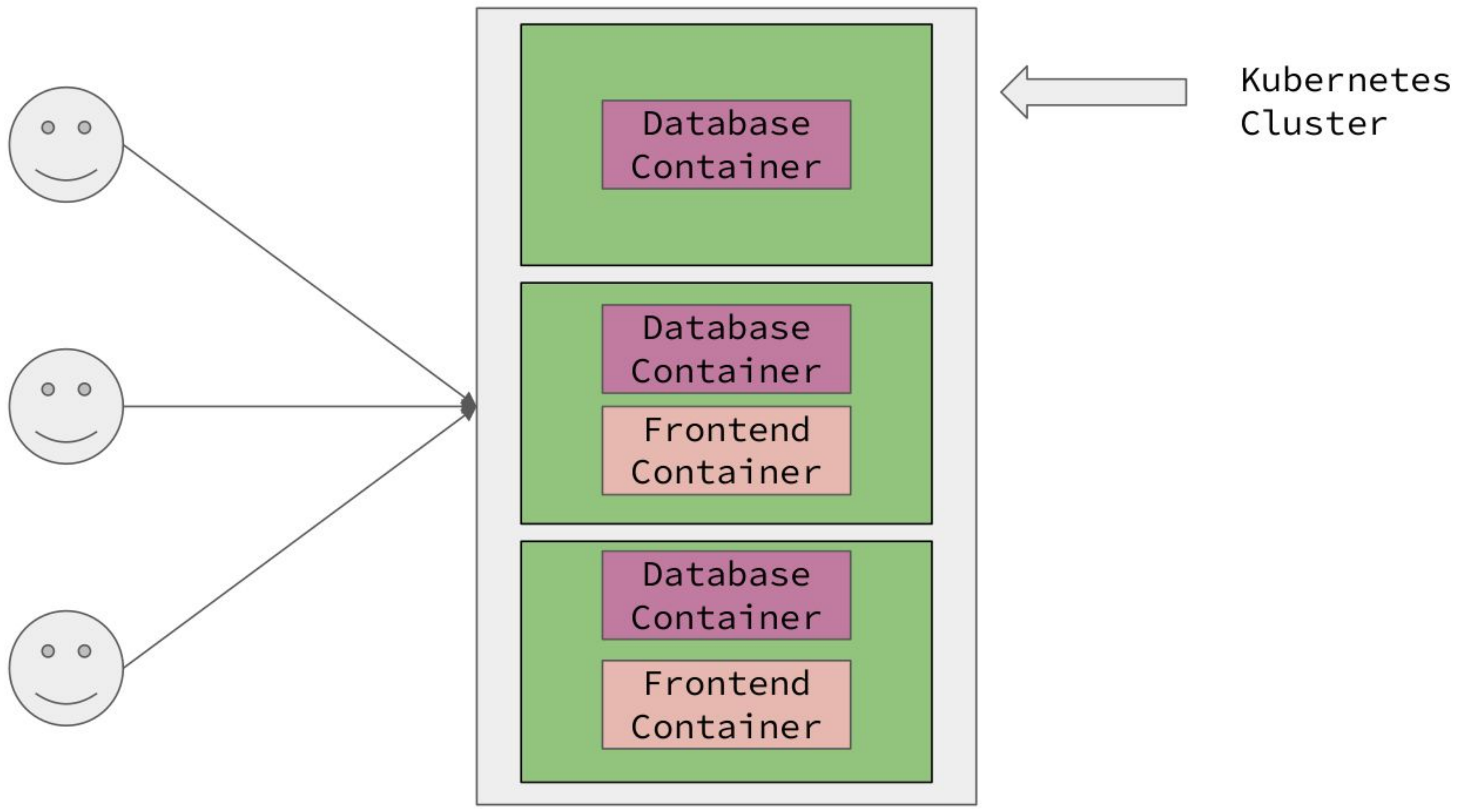
Application Migration

- **6 Strategies (The 6 "R"s)**
  - Ex: Refactor approach (v2)



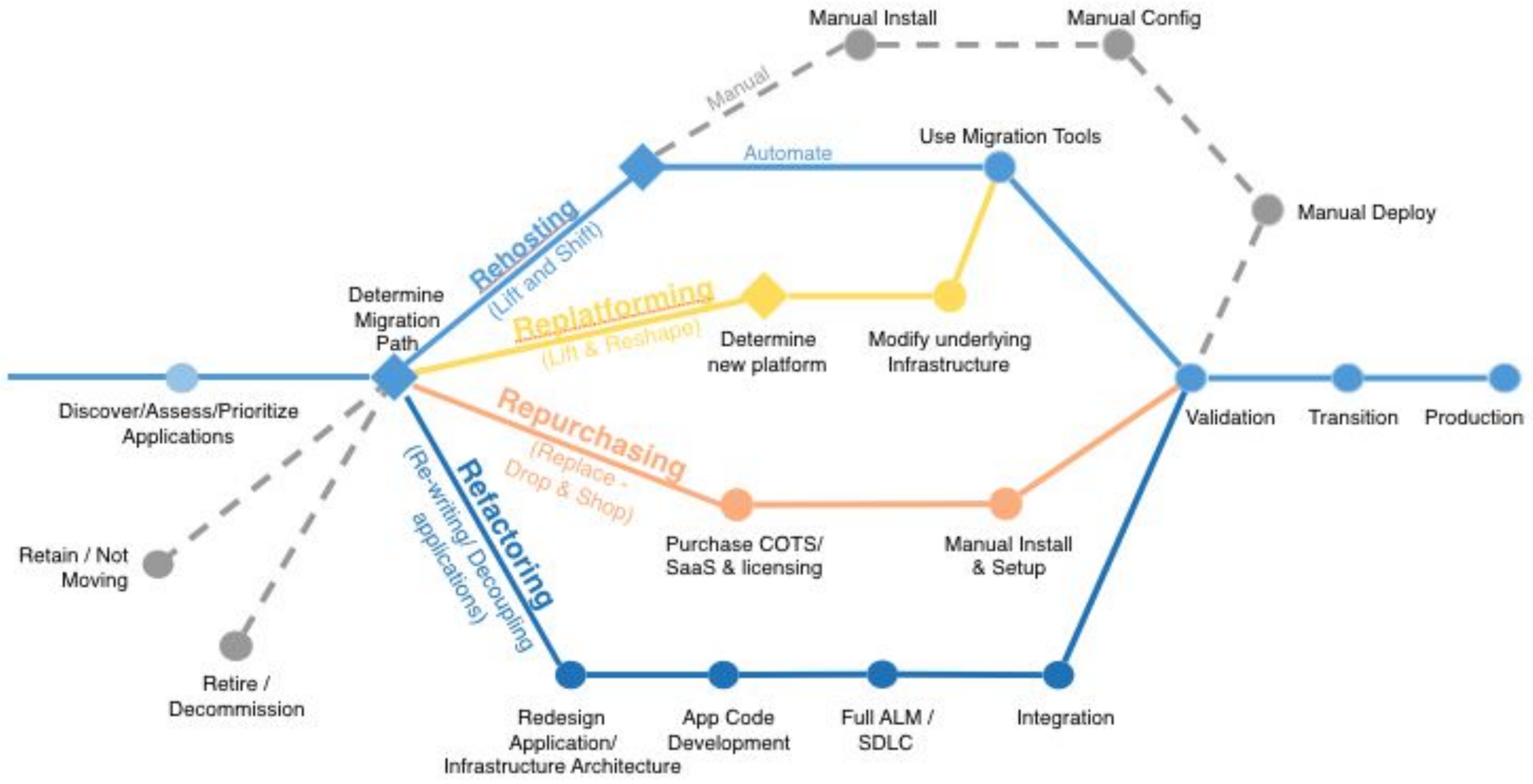
Application Migration

- **6 Strategies (The 6 “R”s)**
  - Ex: Refactor approach (v3)



Application Migration

- **6 Strategies (The 6 "R"s)**



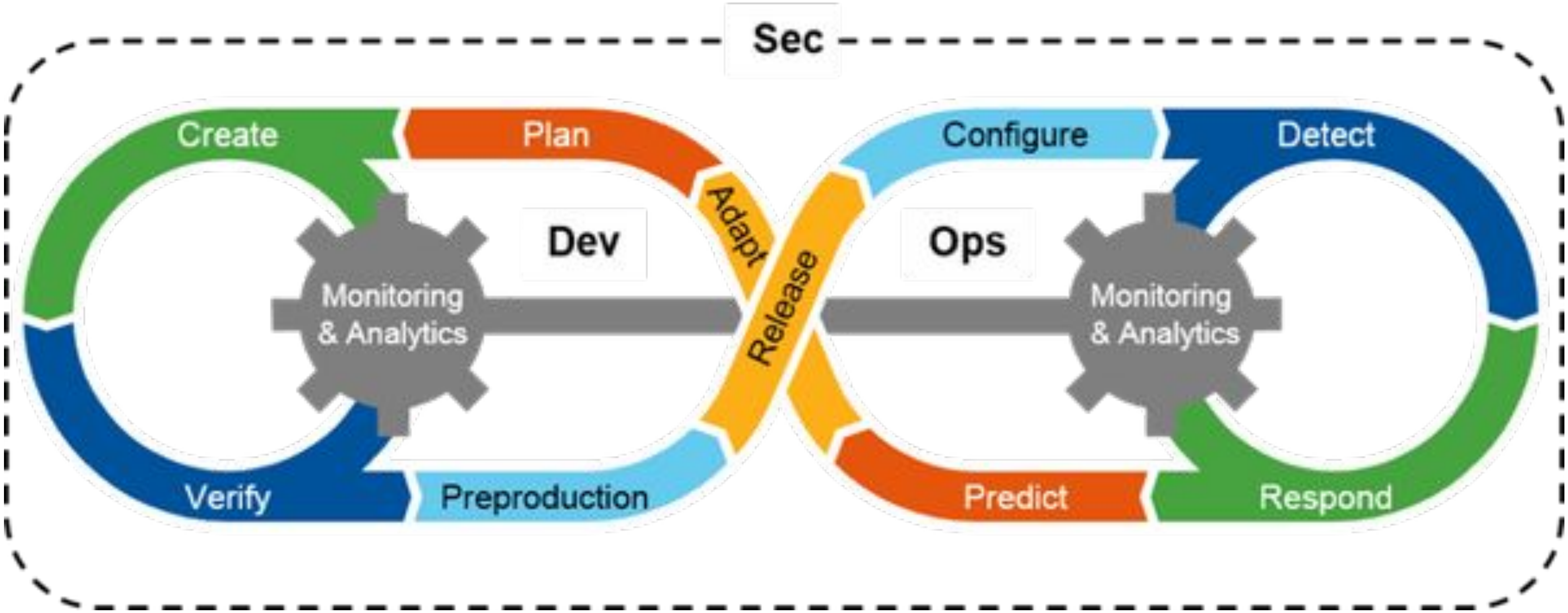
https://aws.amazon.com/blogs/enterprise-strategy/6-strategies-for-migrating-applications-to-the-cloud/

Operation

- **Modern Operating Model**
  - Finally, as applications are migrated, you iterate on your new foundation, turn off old systems, and constantly iterate toward a modern operating model.
  - It’s forcing function to adopt a **DevOps** culture
  - Operating model is an evergreen set of people, process, and technology that constantly improves as you migrate more applications
    - Ideally, you’re building off the foundational expertise you’ve developed before you created your business case
    - If not, use your first few application migrations to develop that foundation, and your operating model will **continually improve** and become more sophisticated as your migration “factory” accelerates
  - DevSecOps?
    - DevOps prioritizes delivery speed, DevSecOps shifts security to the left
    - Initially, DevSecOps practices may increase the development time but will ensure that the codebase is secure from its inception

Security & Privacy

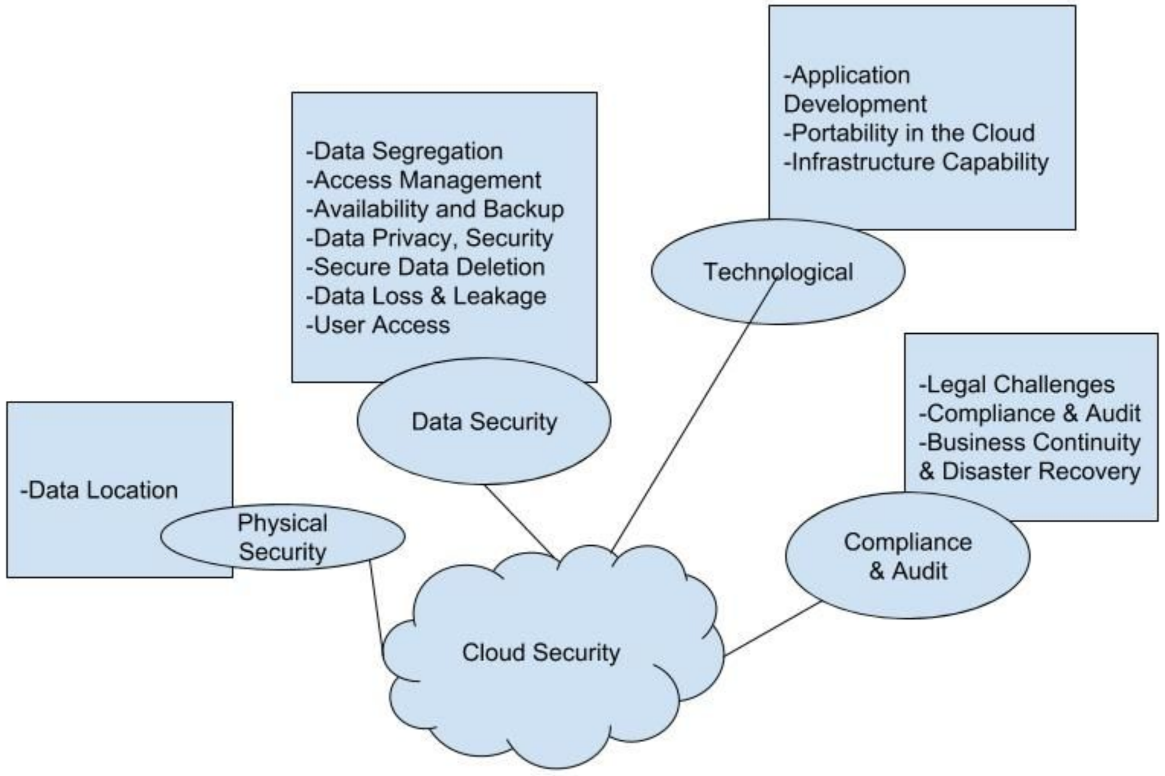
- **DevSecOps**
  - Integrate security into DevOps



https://www.quora.com/What-is-the-difference-between-DevOps-and-DevSecOps

Security & Privacy

- **Security**
  - Protecting the system as a whole
- **Privacy**
  - Protecting the users' data



https://www.cse.wustl.edu/~jain/cse570-15/ftp/cld_sec/index.html

Q/A