



Migration strategy of an e-commerce application to Azure:

The Architecture Diagram.

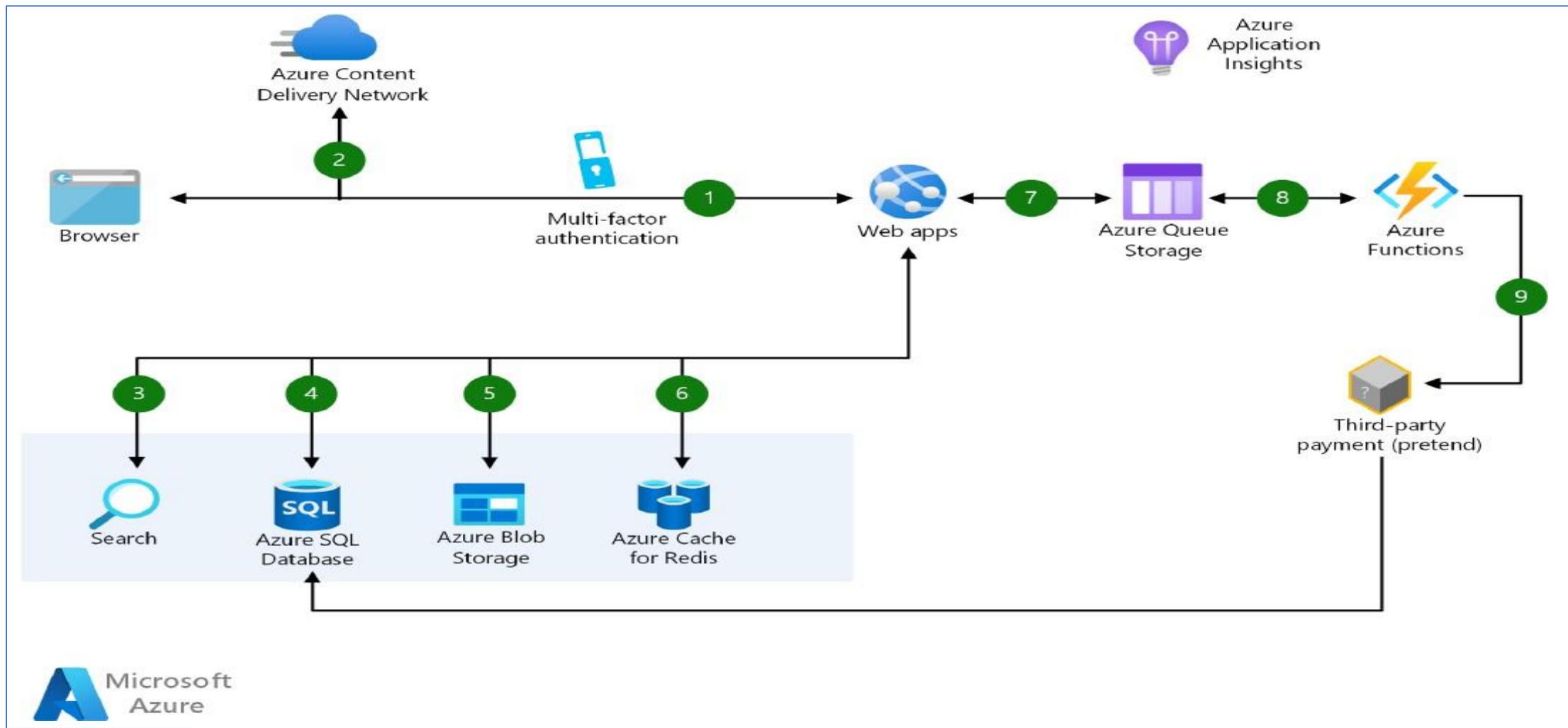


FIGURE 1

FIGURE 1

ASSUMPTIONS

- **Rehosting** entails moving applications to the cloud as-is and is sometimes referred to as **lift and shift**
- The on prem solution is a classic 3 tier web application that is a monolith.
- All components are hosted on VMs
- **Figure 2** is the on-prem reference architecture.

LEGACY WEB APPLICATION ARCHITECTURE

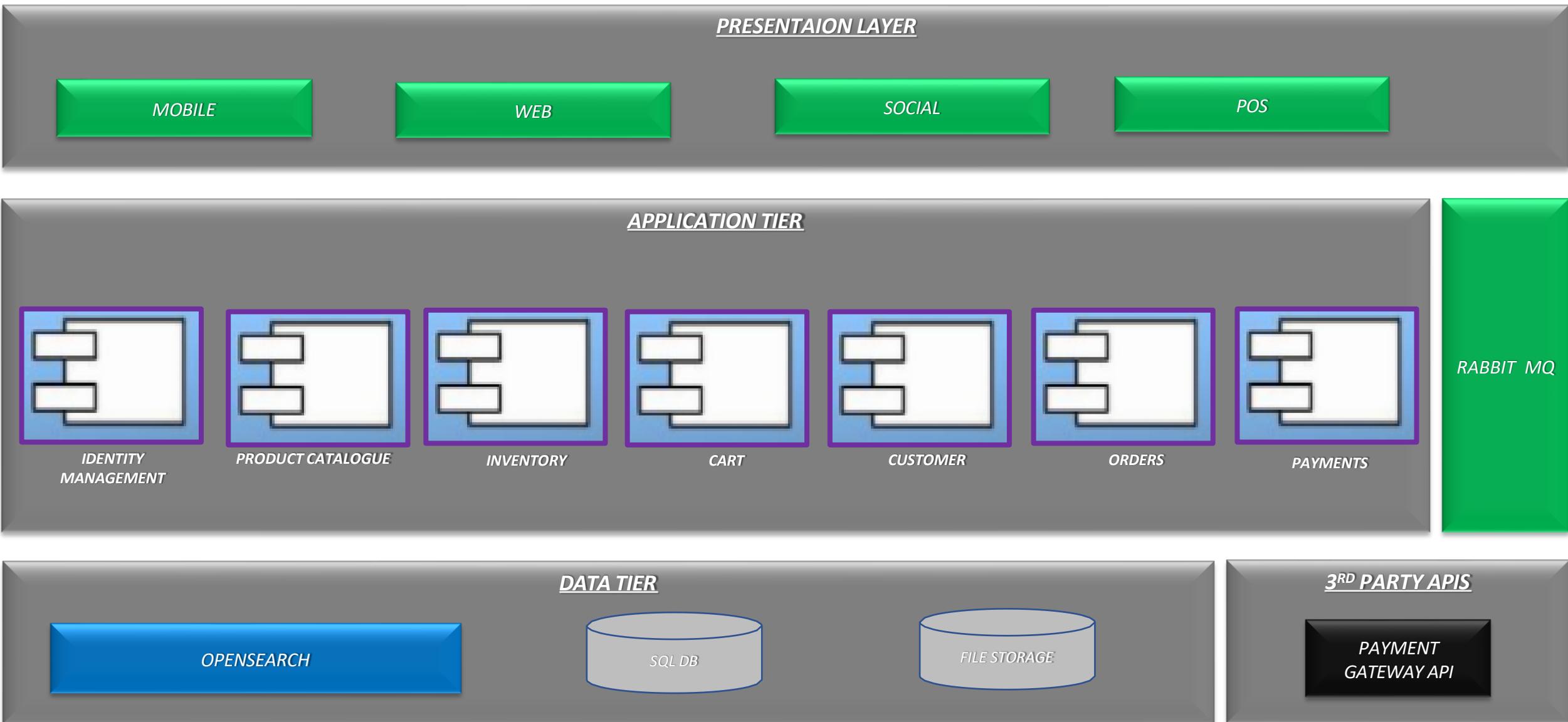


FIGURE 2

QUESTION

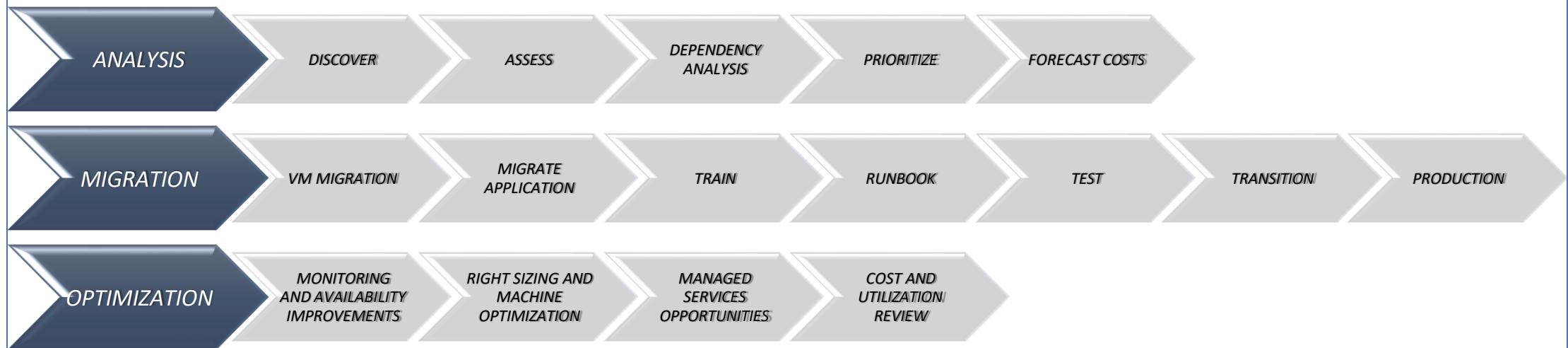
1) Taking the above deployment plan into account, devise a plan for migrating the on-premises e-commerce application to the Azure cloud, using the below phases. Also, list the Azure services that may be required in each phase

REHOSTING

a) *Rehosting - Also referred to as "lift and shift," this stage entails migrating physical servers and VMs as-is to the cloud. By simply shifting your current server environment straight to IaaS*

- i) *Analysis*
- ii) *Migration*
- iii) *Optimization*

REHOSTING



REHOSTING

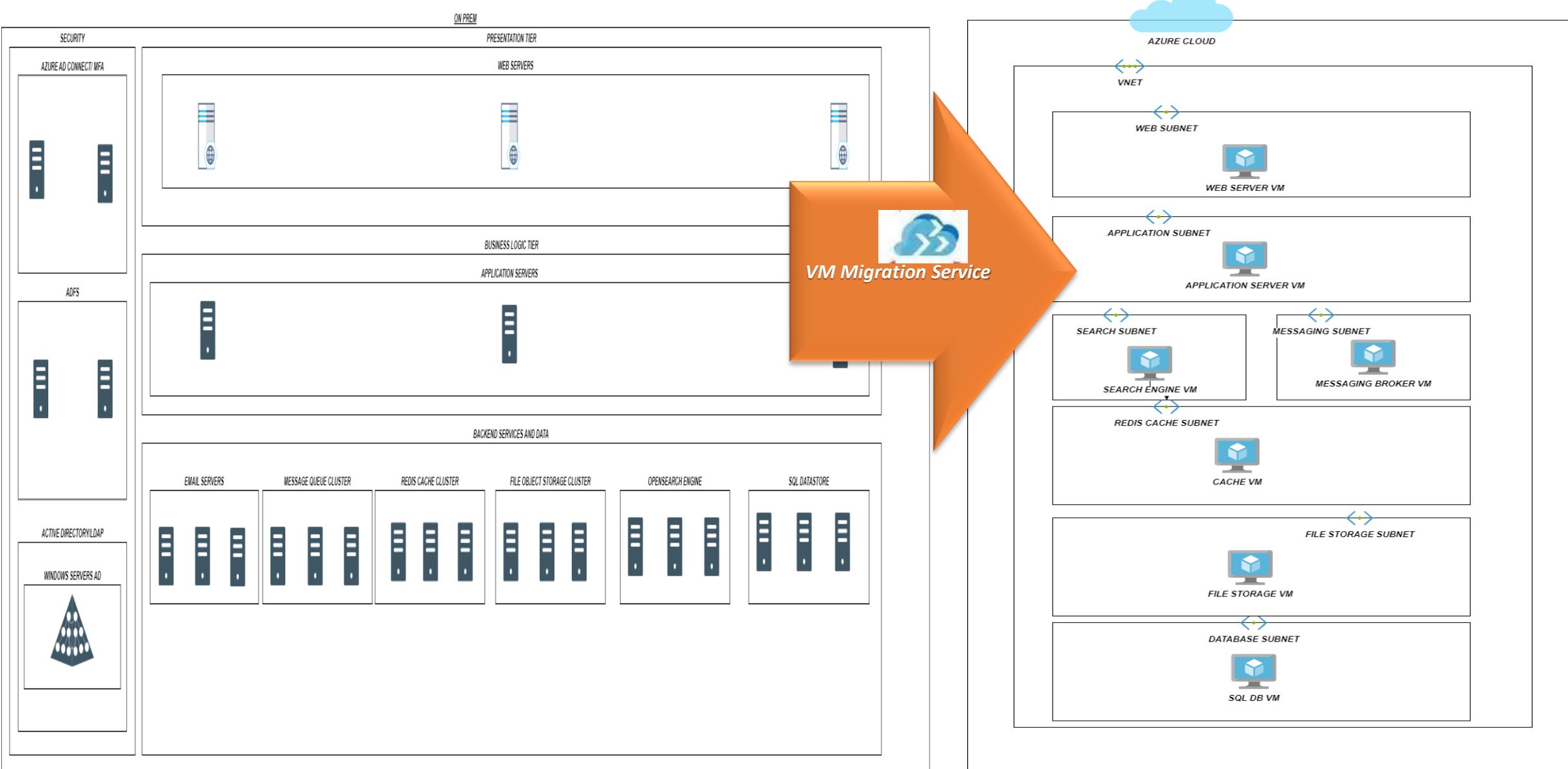


FIGURE 3

ANALYSIS

Phase	Activity	Step	Description	Service	Outcome
1. ANALYSIS	DISCOVER	List of on-prem servers and applications	<ul style="list-style-type: none"> Create Azure Migrate Project on portal and obtain key Deploy and configure Azure Migrate VM appliance on-premises Get infrastructure deployment model of the e-commerce application Install agent on each machine, i.e. on <ul style="list-style-type: none"> each web server in presentation tier each application server in the business logic tier each server in email cluster each server in message cluster each server in the file storage cluster each server in the search engine cluster each server in the SQL cluster Each server in MFA cluster Each server in Active Directory cluster 	<ul style="list-style-type: none"> Application Inventory Azure VM appliance Agent Azure Migrate Server Assessment 	<ul style="list-style-type: none"> Discovered Servers
		Dependency analysis	<ul style="list-style-type: none"> Configure dependency visualization for Windows and Linux machines Get all the server relationships 	<ul style="list-style-type: none"> Azure Migrate 	<ul style="list-style-type: none"> Service Map
	ASSESSMENT	Analyze VM	<ul style="list-style-type: none"> Run as-is on-premises assessment on discovered VMs Assessment returns: <ul style="list-style-type: none"> Azure readiness of discovered VMs Estimation of monthly compute and storage costs Estimated monthly storage cost for disk after Azure migration Review VMs that may have incompatible operating systems and note the risks 	<ul style="list-style-type: none"> Discovered Servers 	<ul style="list-style-type: none"> Assessment
	PRIORITIZE	Create Budget	<ul style="list-style-type: none"> Map workloads to correctly sized VMs Use Azure Hybrid benefit for <ul style="list-style-type: none"> Windows Server running in IIS web servers Windows Server running in IIS SQL server 	<ul style="list-style-type: none"> Assessment 	<ul style="list-style-type: none"> Budget

MIGRATE

Phase	Activity	Step	Description	Services	Outcome
2. MIGRATE	MIGRATE	VM Migration	<ul style="list-style-type: none"> <i>Create Azure migrate project and assign VM contributor role to</i> <ul style="list-style-type: none"> <i>Create VM in selected resource group</i> <i>Create VM in selected virtual network</i> <i>Write to Azure managed disk</i> <i>Create Azure Virtual Network</i> <i>Setup Replication appliance</i> <ul style="list-style-type: none"> <i>Hosts configuration server to coordinate communications between on prem and Azure and manages data replication</i> <i>Process server which acts as a replication gateway and sends data to storage account. It also installs mobility service agent on VMs</i> <i>Register appliance</i> <i>Backup Data</i> <i>Replicate VMs to target</i> <i>For Data, use DB migration service</i> <ul style="list-style-type: none"> <i>Ensure schema compatibility with target instance before replication</i> <i>Install Bastion in virtual network to connect to VMs and edit DB connections after migration</i> <i>Enable backup and disaster recovery</i> <i>Execute data sync between on prem and cloud</i> 	<ul style="list-style-type: none"> <i>Replication appliance</i> <i>Mobility service</i> <i>Azure virtual network</i> <i>Microsoft Entra ID</i> <i>Azure Site Recovery</i> <i>Azure DB Migration service</i> 	<ul style="list-style-type: none"> <i>VM Migration to target resource group</i>
		<i>Test</i>	<ul style="list-style-type: none"> <i>Test Migration</i> <i>User Acceptance testing</i> 	<ul style="list-style-type: none"> <i>Test Plan</i> 	<ul style="list-style-type: none"> <i>Test Results</i>
		<i>Transition</i>	<ul style="list-style-type: none"> <i>Run both on prem and Cloud Deployment to observe behavior</i> <i>Cutover to cloud</i> <i>Remove on prem VMs from local machine</i> <i>Update Internal documentation of new environment</i> 		<ul style="list-style-type: none"> <i>Documentation</i> <i>Runbook</i>
		<i>Production</i>	<ul style="list-style-type: none"> <i>Decommission on prem</i> <i>Use Azure Site Recovery for Business continuity</i> 		<ul style="list-style-type: none"> <i>Cost</i>

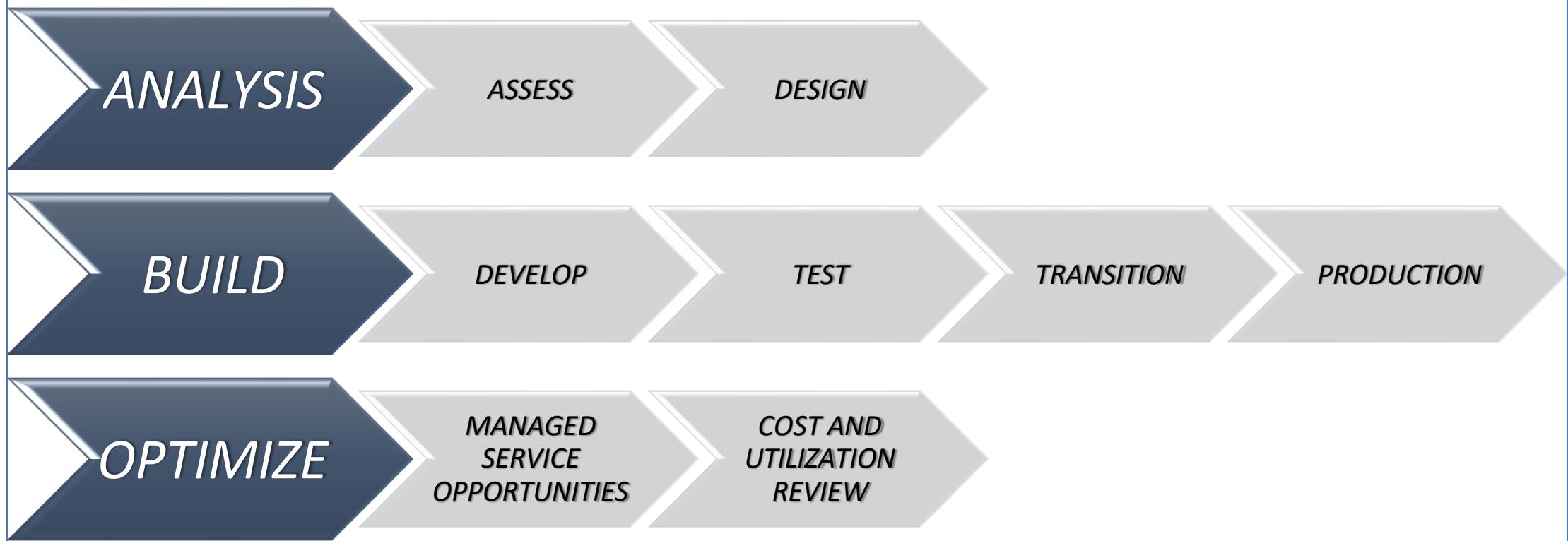
OPTIMIZE

PHASE	ACTIVITY	DESCRIPTION	SERVICES
3. OPTIMIZE	<ul style="list-style-type: none"> <i>Availability Improvements</i> 	<ul style="list-style-type: none"> <i>Monitor utilization of servers and take advantage of scaling and availability capabilities of resource cloud providers such as hosting apps in different availability zones for resiliency</i> 	
	<ul style="list-style-type: none"> <i>Right sizing and machine optimization</i> 	<ul style="list-style-type: none"> <i>Monitor VM utilization and correctly size the it with appropriate specification of SKU</i> 	
	<ul style="list-style-type: none"> <i>Managed service opportunities</i> 	<ul style="list-style-type: none"> <i>Explore opportunities to use Azure managed instance SQL Databases instead of VMs</i> <i>Use Azure blob storage to replace file object storage servers</i> <i>Look at using Azure WAF as a threat protection firewall</i> <i>Use azure approved and managed OS on VMs</i> <i>Consider Azure Web Apps for web applications</i> <i>Consider Azure web application Gateway to manage web traffic for the different channels, i.e. mobile, web, social, poss.</i> <i>Explore opportunities for replacing opensearch server cluster with Azure Search</i> 	<ul style="list-style-type: none"> <i>Azure Advisor</i> <i>Network Watcher</i> <i>Application Insights</i> <i>Azure Machine Virtual Extensions</i> <i>Microsoft Cost Management</i>
	<ul style="list-style-type: none"> <i>Security</i> 	<ul style="list-style-type: none"> <i>Secure Data by backing up VMs using Azure Backup Services</i> <i>Restrict network</i> <i>Encrypt data</i> <i>Use Azure B2C to authenticate customers</i> 	
	<ul style="list-style-type: none"> <i>Cost Management</i> 	<ul style="list-style-type: none"> <i>Use Microsoft cost management to do cost benefit analysis and monitor ROI</i> 	

QUESTION

b) Refactoring - Application Refactoring is the rewriting of one or more components of an application, typically to take advantage of public cloud services. This can also involve refactoring the traditional application from a legacy 3-tier application design to granular, microservices based applications.

~~REFINE~~ REFACTOR



ASSUMPTIONS

- The shopping cart checkout process is depicted on **page 15**
- The capability model of the e-commerce app is represented on **page 16**
- Microservices reference architecture is represented by **Figure 4 on page 17**
- The desired target reference architecture when breaking up the monolithic application is depicted in **Figure 5 on page 18.**
- Steps 1,2,3,4 in **Figure 5** represent the sequential iteration of refractor initiatives

SHOPPING CART CHECKOUT PROCESS



SHOPPING CART CAPABILITIES

PRODUCT MANAGEMENT

PRODUCT CATALOG

PRODUCT SEARCH

PRICES

DEALS AND PROMOTIONS

INVENTORY MANAGEMENT

PRODUCT INVENTORY

CUSTOMER SERVICE

CUSTOMER PROFILES

BILLING INFO

SHIPPING INFO

ORDER

ORDERS

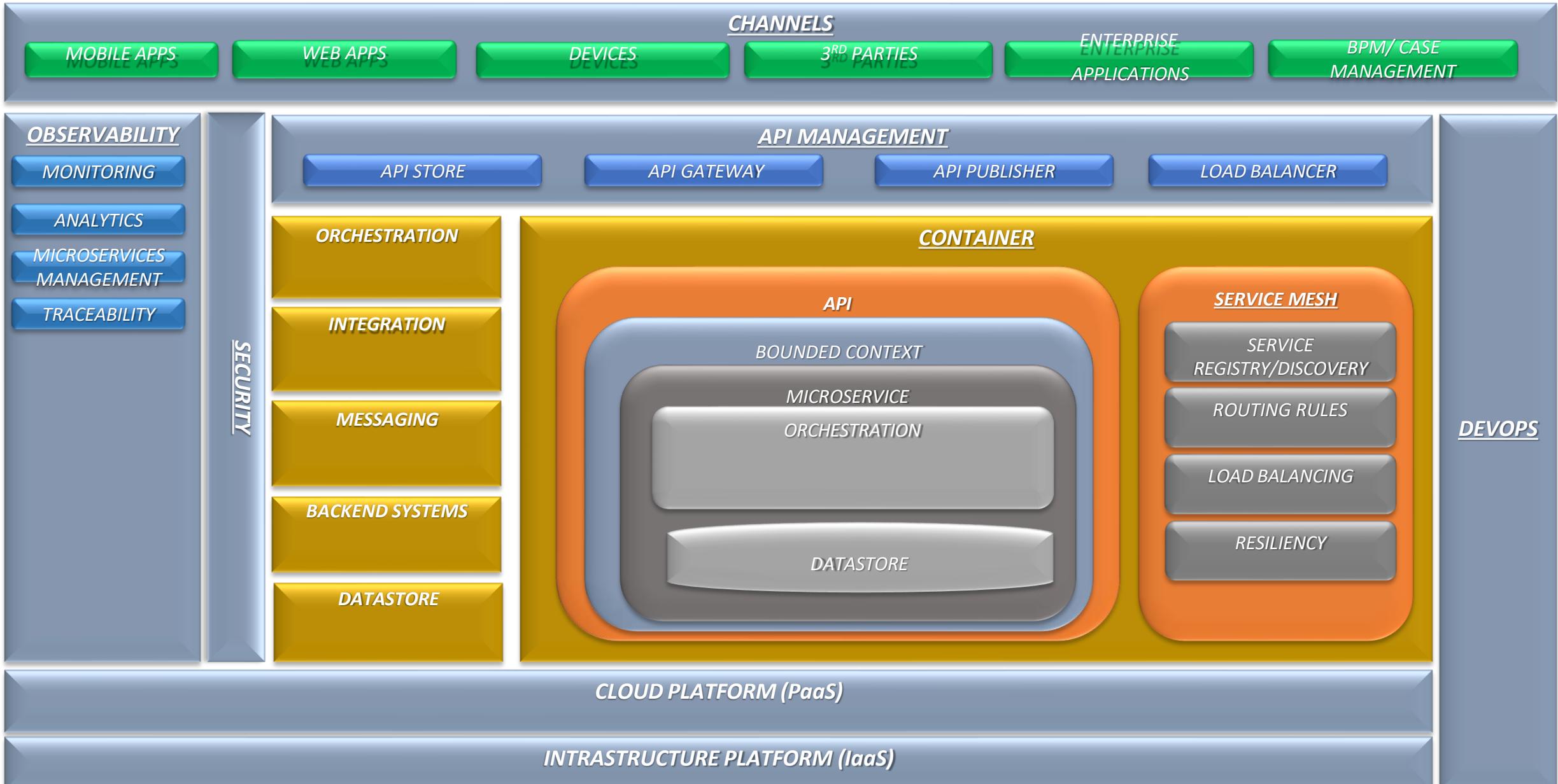
RETURNS

PAYMENT

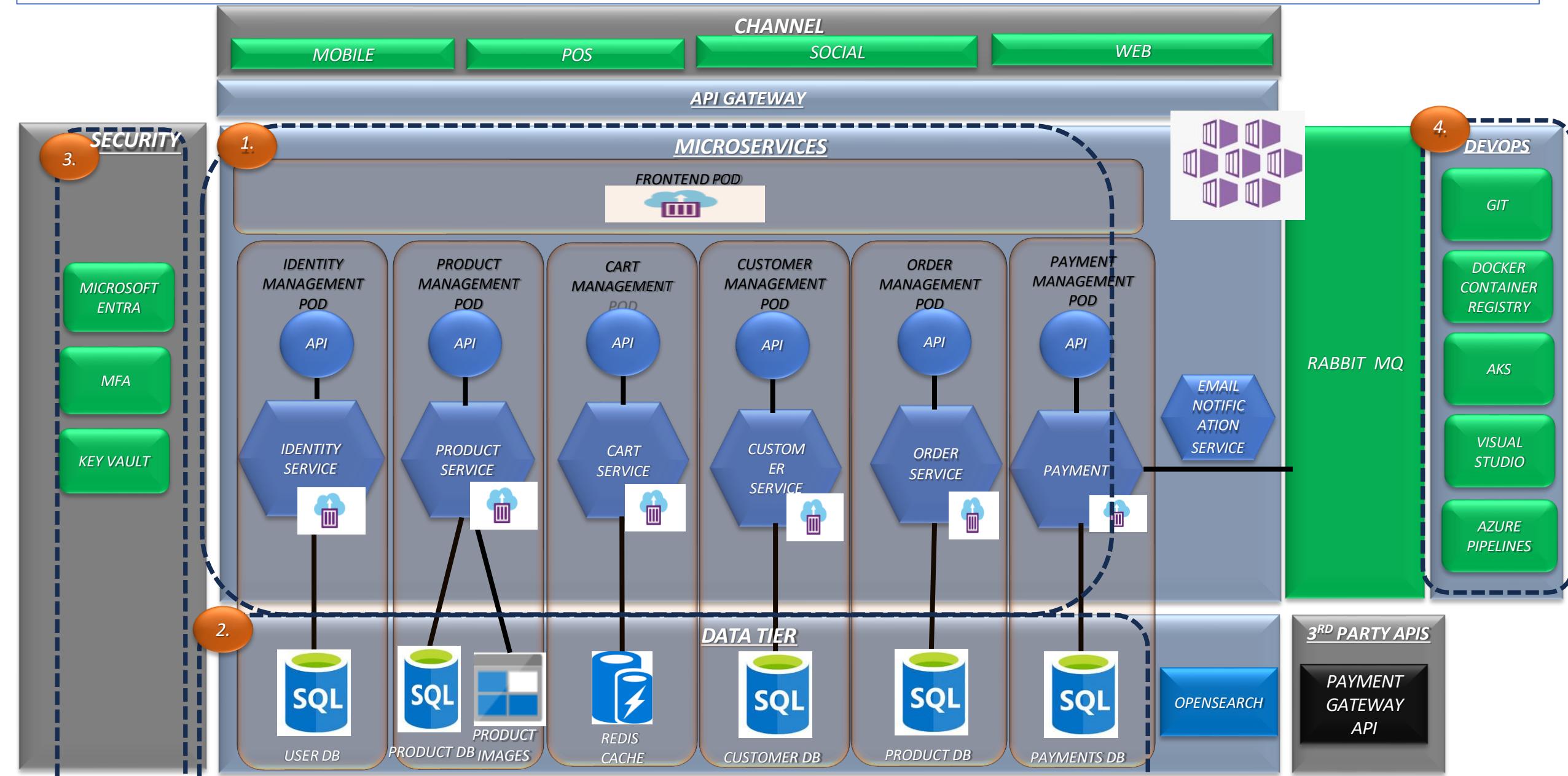
CONFIRMATION

EMAIL

MICROSERVICES REFERENCE ARCHITECTURE



REFACTOR TARGET ARCHITECTURE



APPLICATION DEVELOPMENT LIFECYCLE

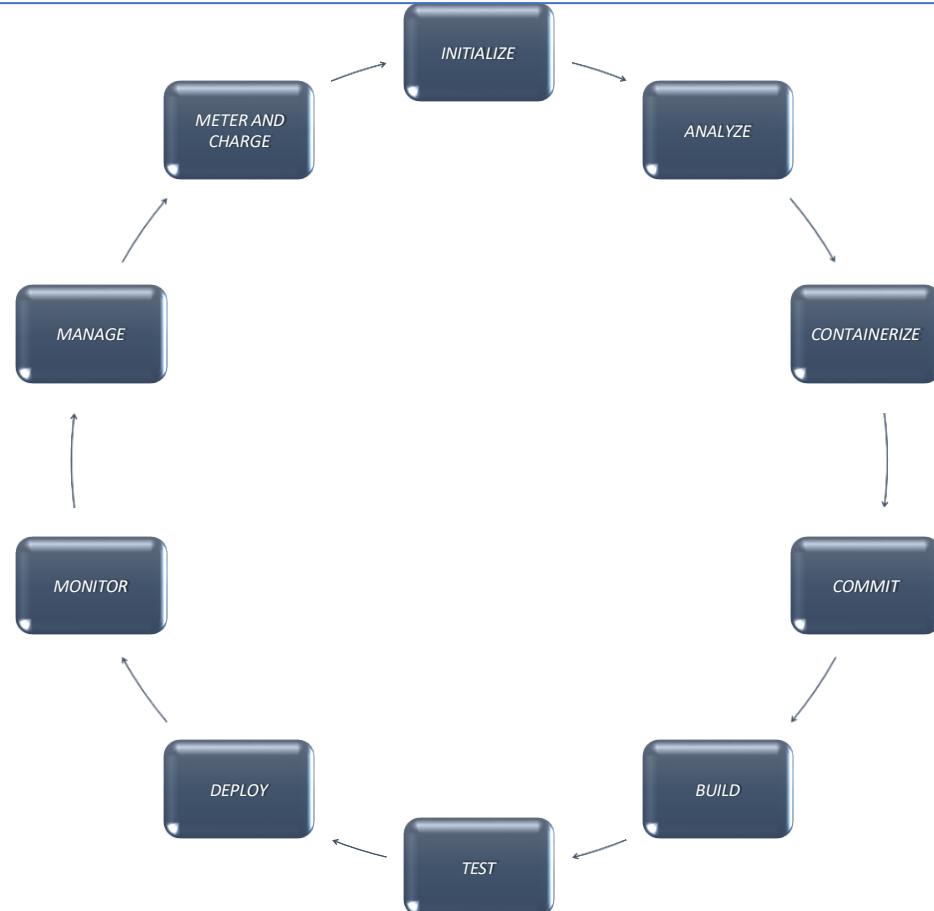


FIGURE 6

ANALYSIS

PHASE	ACTIVITY	STEP	DESCRIPTION	SERVICES
1. ANALYSIS	ASSESSMENT	Identify microservice candidates	<ul style="list-style-type: none"> Candidate Services: Microservices are capability oriented in nature. The e-commerce monolithic application can be broken down into the following services with bounded contexts: Inventory, Product, Cart, Customer, Order and Payment microservices. Use Domain driven design to achieve bounded contexts, These are to be containerized New Data Schema: for new refactored services with bounded contexts. 	<ul style="list-style-type: none"> Discovered Servers AKS Azure Container Registry Git/Azure Code Repo
	PRIORITIZE	Identify Managed Instance database candidate	<ul style="list-style-type: none"> Data: Since microservices each have their own data base, a new data model is required to denormalize data structures for Inventory, Product, Cart, Customer, Order and Payments databases. 	<ul style="list-style-type: none"> Azure SQL Managed Instance Data Factory
		Storage	<ul style="list-style-type: none"> Unstructured Data: Leverage Azure Blob storage to store product images with intent to decommission file storage VMS 	<ul style="list-style-type: none"> Azure Blob Storage
		Security	<ul style="list-style-type: none"> Identity Access Management: Design to externalize security out of code and leverage Azure platform capabilities to enhance security MFA: Use Azure out of the box MFA capabilities Use Azure Key vault to protect passwords and to prevent them from being plain text and make them configurable. 	<ul style="list-style-type: none"> IAM Azure Active Directory (B2B) and (B2C) Key Vault

MIGRATE

Phase	Step	Description	Input Tools
2. BUILD	<i>Build</i>	<ul style="list-style-type: none"> Infrastructure: Script infrastructure components Code, Data and Configurations: How will code and artifacts be migrated and deployed when updated. A CI/CD strategy needs to be formulated. There has to be once code base tracked in revision control, no manual deployments. Adopt a DevSecOps model Application Development: The 12 factor application development principles need to be embedded in newly modernized applications to be migrated. Development Toolkit: A development toolkit has to be standardized considering that many tools used to develop the legacy application will become redundant and testing strategies will change now that the application will have a distributed nature in the cloud. Leverage supported images for containerization to eliminate the risk 	<ul style="list-style-type: none"> AKS Azure Container Registry Git/Azure Code Repo Azure Pipelines
	<i>Test</i>	<ul style="list-style-type: none"> <i>Test Migration</i> <i>User Acceptance testing</i> 	<ul style="list-style-type: none"> <i>Test Plan</i>
	<i>Transition</i>	<ul style="list-style-type: none"> <i>Run blue green deployment to observe behavior</i> <i>Cutover to new implementation</i> <i>Update Internal documentation of new environment</i> 	
	<i>Production</i>	<ul style="list-style-type: none"> <i>Decommission old environment</i> 	

OPTIMIZE

PHASE	ACTIVITY	DESCRIPTION	TOOLS
3. OPTIMIZE	<ul style="list-style-type: none">• <i>Improvements</i>	<ul style="list-style-type: none">• <i>Monitor Review costs</i>• <i>Explore commoditzing API management and secure API gateway for secure, discoverable and scalable services since we have adopted the microservices paradingm.</i>• <i>Observability:</i> <i>Explore Azure logging, auditing and monitoring services for telemetry and operational insights into services</i>	<ul style="list-style-type: none">• <i>Azure Monitor</i>• <i>Network Watcher</i>• <i>Application Insights</i>• <i>Microsoft Cost Management</i>

REBUILD

DISCOVER

DESIGN

BUILD

LAUNCH

IMPROVE

REBUILD TARGET ARCHITECTURE

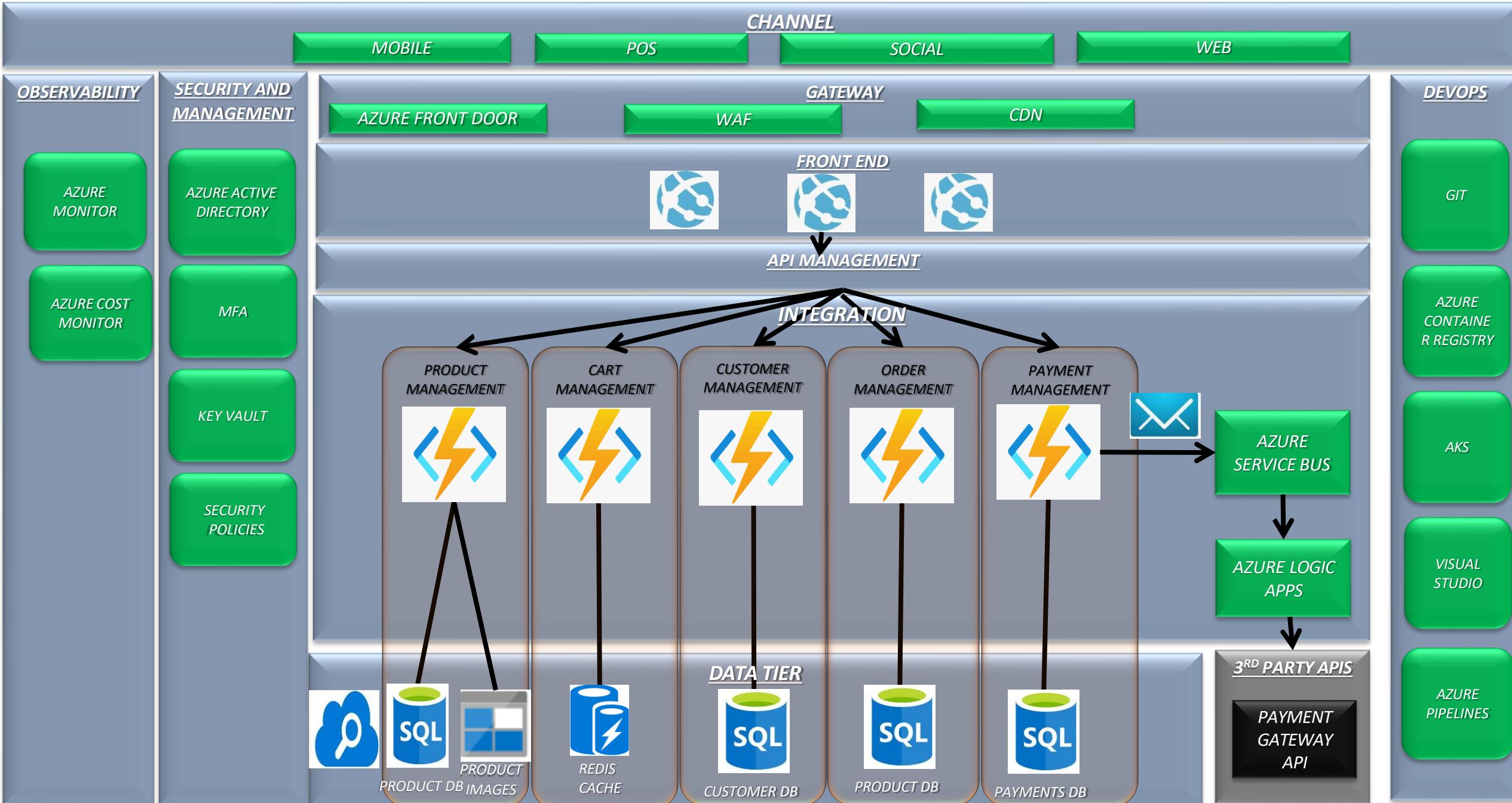
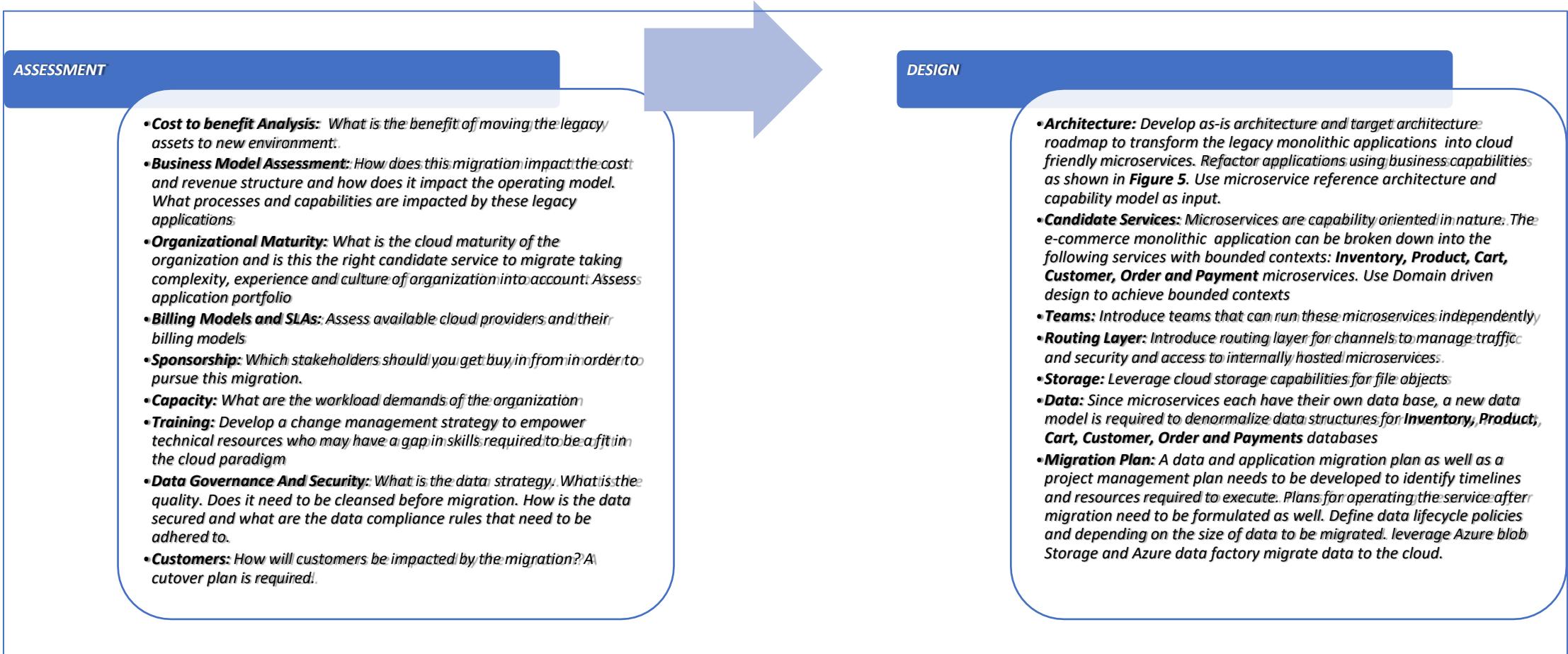
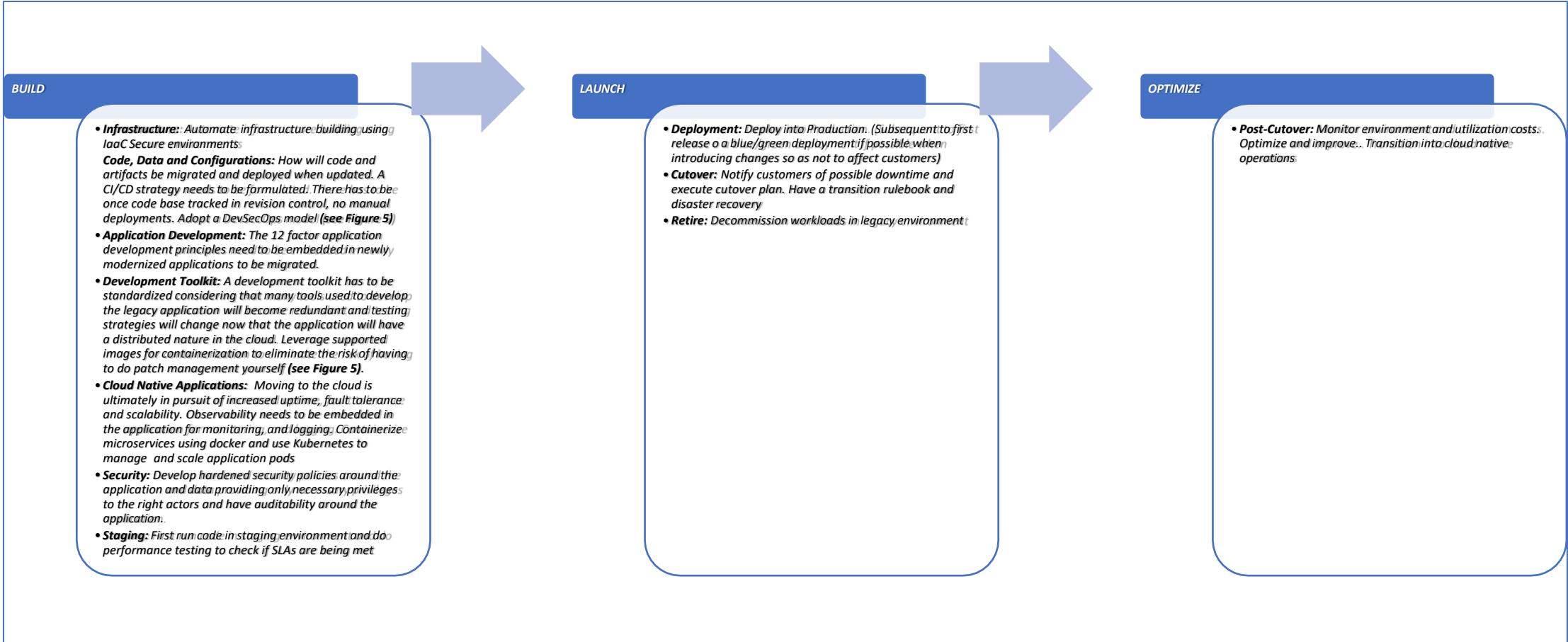


FIGURE 2

ANSWERS



ANSWERS



QUESTION

2) Calculate the monthly cost of deploying the e-commerce application on Azure based on the given deployment plan. Assume an enterprise similar to [Walmart Online](#). For simplicity, you can scale down the numbers and mention the assumptions in the submission. - 10 points

FORMULAS TO NOTE

- **IOPS** = $(\text{Throughput} / \text{Kilobytes per input-output operations}) \times 1024$
- **MEMORY** = $[(\text{Peak number of users}) \times (\text{Maximum amount of memory in MB per user})] / 1024$
- $(\text{Threads} \times \text{Cores}) \times \text{Physical CPU Number} = \text{Number of vCPUs}$
- $\text{Number of CPU cores} / \text{Average time for request (in seconds)} = \text{Max number of Requests per second.}$
- **Total Minimum servers required** = $(\text{Total memory} \times \text{redundancy}) / \text{Maximum amount of memory a server can acquire}$
- $[\text{available bandwidth}] / ([\text{average bitrate per stream}] \times 1.2)$

WEB APP SERVER REQUIREMENTS

- Checkout process is depicted on page 15
- Let's assume 10 000 customers can transact in a day
- Let's assume the peak number of users transacting per day is 4000.
- Let's assume each activity consumes 100KB
- Average request size = 100KB
- Bitrate = $(\text{request size} * \text{number of peak users} * \text{bits})/\text{duration} = 700 * (4000 * 0.8 * 8) / (60 * 60) = 711 \text{ Kbps}$
- Concurrent Users = $[\text{available bandwidth}] / ([\text{average bitrate per stream}] \times 1.2) = 5 \text{ Gbps} / (711 * 1.2) = 5860$
- Required Throughput = $(700 * 4000 * 0.8) / (24 * 60 * 60) = 64.81 \text{ Kps} = 512 \text{ Kbps}$
- Requests per second for CPU bound RPS = Total number of requests/task duration = $[(4000 * 0.8) / (60 * 60)] / (10 \text{ ms}) = 88$
- A 2 core server can handle RPS = Number of cores/duration = $2 / 0.01 = 200 \text{ RPS}$
- Number of Azure instances = $88 / 200 = 0.44 \Rightarrow 1$ 2 core 3.5GB RAM, 10GB storage Web app instance can handle 10000 users a day, enable autoscaling for peak workloads

STORAGE REQUIREMENTS

- *Storage size required = (sum of characters * amount of records)/1024*
- *We have the following SQL database tables:*
 - *Customer*
 - *Orders*
 - *Payments*
 - *Products*
 - *Inventory*
 - *Cart*
 - *Deals*
- *Let's assume for simplicity they are equal size, 50GB and can accommodate 10000 users per day*
- *Total Storage = 50GB * 7 * 2 safety factor = 700GB*
- *Assume 10GB storage requirement for Product images*

TEAMS TO RUN APPLICATION



RUNNING COSTS

Line Items	Type	Count	Weekly Costs (\$)		Monthly Costs(\$)		Year 1 {\$}	
			Compute Pay as you go	Reserved Instances	Compute Pay as you go	Reserved Instances	Compute Pay as you go	Reserved Instances
Web Tier								
Azure CDN			0.07	0.07	0.32	0.32	3.84	3.84
Azure App Service	S2 (2 Core(s), 3.5 GB RAM, 50 GB Storage)	2.00	67.38	67.38	292.00	292.00	3,504.00	3,504.00
Integration Tier								
Azure Queue Storage	RA-GRS	1.00	44.95	44.95	194.80	194.80	2,337.60	2,337.60
Azure Functions (Payments)	EP2: 2 Cores(s), 7 GB RAM	3.00	214.99	178.44	931.63	773.25	11,179.56	9,279.00
Data Tier								
Redis Cache	Standard tier; 3 CO instances	3.00	27.80	27.80	120.45	120.45	1,445.40	1,445.40
Azure Search		0.00	0.00	0.00	0.00	0.00	0.00	0.00
Azure SQL	Standad Series Gen 5 (4 vCore)	7.00	3,204.84	2,415.02	13,887.65	10,465.08	166,651.80	125,580.96
Azure Blob Storage	Hot tier access RA-GRS		52.32	52.32	226.73	226.73	2,720.76	2,720.76
Azure Monitor								
Cloud Engineers	AWS Cloud Engineer	14.00	55,827.69	55,827.69	241,920.00	241,920.00	2,903,040.00	2,903,040.00
Training	Cloud Computing Training	14.00	923.08	923.08	4,000.00	4,000.00	48,000.00	48,000.00
Total			60,363.13	59,536.76	261,573.58	257,992.63	3,138,882.96	3,095,911.56
Up Front Cost				139.00		139.00		139.00

QUESTION

- *Identify the risks associated with migrating the application to the cloud and suggest ways of mitigating them.*

ANSWER

- **Lack Of Transparency** due to infrastructure being managed by provider
 - Implement cost monitoring and management
- **Insecure Integrations and APIs** that can be accessed without restrictions.
 - Use industry standard authorization and authentication protocols and access control policies
- **Identity Theft** due to credentials being entered on the internet
 - Use Multi factor authentication
- **Data Sovereignty** due to different compliance laws in different countries restricting where data can be stored
 - Check country and jurisdiction compliance about data storage and ownership

QUESTION

Devise a 2-minute brief (100 words or less) to convince senior management of the benefits and criticality of performing this migration task.

ANSWER

- The migration of the e-commerce from legacy on prem implementation style to cloud allows reduction in capex associated with IT technology assets.
- The pay per use model of cloud allows for improved budgeting since the operational expenditure of IT assets is predictable and can be forecasted.
- Reduced on prem infrastructure reduces management overheads and opacity of exponentially increasing IT costs
- The guaranteed availability and scalability of services due to the cloud characteristics reduces the advent of reputational risk due to services being unavailable to customers
- Elastic and durable infrastructure that scales in and scales out based on spending habits of global customer segment.