Into the Cloud

Deployment for images

As things stand

- Built Docker images
- Optimized image sizes
- Pushed to container registries
- Managed versions and tags

Next Challenge: Where Do Containers Actually Run?

> *Your image is ready. Now you need to deploy it to Azure!*

The Deployment Landscape

Azure offers a **spectrum of options** from simple to more complex.

Less Control, Less Management

- Azure Container Instances (ACI)
- Azure App Service
- Azure Container Apps

You tend to get more control the more complex it gets!

More Control, More Complexity

Managed Kubernetes on Azure

- Azure Kubernetes Service (AKS)

Understanding Container Engines

You've been using Docker - but what's actually running your containers?

A container engine is the software that:

- Creates containers from images
- Manages container lifecycle
- Handles networking and storage
- Enforces resource limits

Popular Container Engines

Engine	Description	Use Case
Docker	Most popular, easy to use	Development & simple deployments
containerd	Lightweight, industry standard	Production, Kubernetes
CRI-O	Kubernetes-native	Kubernetes-only environments
Podman	Daemonless, rootless	Security-focused deployments

> ***Azure uses containerd*** *under the hood for AKS and Container Apps!*

Docker vs containerd

Docker:

- Full-featured development platform
- Built-in networking, volumes, compose
- Higher overhead

containerd:

- Minimal runtime (Docker uses it internally!)
- Industry standard for production
- Lower resource usage

Understanding DNS

What is DNS?

DNS = Domain Name System

Think of it as **the internet's phonebook**

- Computers communicate using IP addresses (like `20.123.45.67`)
- Humans prefer names (like `myapp.azurecontainerapps.io`)
- DNS translates names to IP addresses automatically

> *Without DNS, you'd need to remember `172.217.16.206` instead of `google.com`!*

How DNS Works in Practice

When someone wants to access your application:

1. **Your application is typically behind public or private IP address**
    - Example: `20.123.45.67`
2. **DNS maps a friendly name to that IP:**
    - User types: `www.myapp.com`
    - DNS translates: "That's `20.123.45.67`"
    - Browser connects to the IP address

Setting Up DNS: The Traditional Way

To make your container accessible on the internet, you would typically need to:

1. Buy a domain name:

- Register through a registrar (GoDaddy, Namecheap, etc.)
- Annual cost: £10-50+
- Manage renewals

2. Configure DNS records:

- Create A records (domain → IP address)
- Set up CNAME records (aliases)
- Wait for DNS propagation (can take hours!)

3. Set up HTTPS/SSL:

- Purchase SSL certificate OR use free Let's Encrypt
- Install certificate on your server
- Configure web server for HTTPS
- Renew certificates before expiry (every 90 days for Let's Encrypt)

4. Keep everything updated:

- If your server IP changes, update DNS
- Monitor certificate expiry
- Troubleshoot DNS issues

How Cloud Platforms Help

Automatic DNS names:

- Platform provides a domain automatically
- No need to buy or configure initially
- Example pattern: `yourapp.platform-name.azure.com`

Managed HTTPS/SSL:

- Certificates provided and managed
- Automatic renewal
- HTTPS works out of the box

Easy custom domains with DNS zones (when you're ready):

- Simple process to add your own domain
- Guided setup
- Certificate management included

What this means:

- Deploy in minutes instead of hours
- No DNS expertise required to start
- Security (HTTPS) by default
- Focus on building, not infrastructure setup

How Azure Simplifies DNS

Azure container services make this much easier:

Automatic DNS provided:

- **ACI:** `your-label.region.azurecontainer.io`
- **App Service:** `yourapp.azurewebsites.net`
- **Container Apps:** `yourapp.region.azurecontainerapps.io`

HTTPS included by default:

- Managed SSL certificates
- Automatic renewal

Caveats!

Whilst the quick Azure given DNS is nice, it is not best practice to use these for clients and customer facing endpoints. How many websites do you visit that have Azure or AWS in the name?

https://facebook.azure.z35.windows.net doesn't quite sound as good

In the real world, you use custom domains

Azure Container Instances (ACI)

Fastest Way to Run a Container

- Deploy a container in seconds (managed DNS!)
- No servers to manage
- Pay per second of execution
- Great for simple workloads, proof of concepts, or learning!

When to Use ACI

✅ Perfect for:

- Quick demos and testing
- Batch jobs and scheduled tasks
- CI/CD build agents
- Simple background workers
- Isolated task execution

❌ Not ideal for:

- High-traffic web applications
- Complex multi-container applications
- Applications requiring auto-scaling
- Long-running production services

ACI Key Features

Resource Control:

- Specify exact CPU cores and memory
- Pay only for what you provision

Networking:

- Public IP addresses
- Virtual network integration
- DNS name labels

Azure App Service

Platform-as-a-Service for Web Apps

Managed platform for hosting applications:

- Deploy containers or code
- Built-in scaling and load balancing
- Integrated monitoring and diagnostics
- SSL/TLS certificates included

When to Use App Service

✅ Perfect for:

- Web applications and APIs
- Microservices with HTTP endpoints
- Applications needing custom domains
- Teams wanting managed infrastructure
- Applications requiring staging slots

❌ Not ideal for:

- Non-HTTP workloads
- Complex container orchestration
- Batch processing jobs
- Applications needing full Kubernetes features

App Service Key Features

Developer-Friendly:

- Deploy from GitHub, Azure DevOps, Docker Hub
- Automatic OS and runtime patching
- Built-in authentication/authorization
- Easy rollback to previous versions

Enterprise-Ready:

- Auto-scaling (vertical and horizontal)
- Traffic splitting for A/B testing
- Deployment slots (dev, staging, production)
- VNet integration for secure networking

Cost-Effective:

- Shared infrastructure tier available
- Scale up/down based on demand
- Only pay for the App Service Plan

Azure Container Apps

The Modern Container Platform

Built on Kubernetes, without the Kubernetes complexity:

- Microservices-first design
- Event-driven scaling (including to zero!)
- Built-in service discovery
- Managed by Microsoft

When to Use Container Apps

✅ Perfect for:

- Modern microservices architectures
- Event-driven applications
- Applications with variable traffic
- Teams wanting Kubernetes benefits without complexity
- HTTP and background processing workloads

❌ Not ideal for:

- Applications requiring full Kubernetes control
- Windows containers (Linux only)
- Stateful applications requiring persistent storage
- Complex custom networking requirements

Container Apps Key Features

Built for Modern Apps:

- Multiple containers in one application
- Automatic HTTPS ingress
- Service-to-service communication
- Integrated with KEDA for event scaling

Developer Experience:

- Scale to zero (pay nothing when idle!)
- Revisions for versioning and rollback
- Traffic splitting between revisions
- Logs and metrics out of the box

Environmentally Isolated:

- Create environments for different stages (dev, test, prod)
- Shared resources within an environment
- VNet integration for security

Container Apps Scaling

Dynamic and Event-Driven:

Scales based on:

- HTTP traffic load
- Queue length (Azure Storage Queue, Service Bus)
- Custom metrics (CPU, memory)
- Scheduled times
- Other event sources via KEDA

Scale to Zero:

- When no requests = no running containers = no cost!
- Wakes up automatically when traffic arrives
- Perfect for intermittent workloads

Azure Kubernetes Service (AKS)

Enterprise Container Orchestration

Fully-managed Kubernetes on Azure:

- Complete Kubernetes experience
- Maximum control and flexibility
- Industry-standard platform
- Microsoft manages the control plane

What is Kubernetes?

Container orchestration at scale:

- Manages hundreds or thousands of containers
- Automatic load balancing
- Self-healing (restarts failed containers)
- Secret and configuration management
- Storage orchestration

> ***Kubernetes*** *is like a data center operating system for containers!*

When to Use AKS

✅ Perfect for:

- Large-scale microservices applications
- Complex multi-container applications
- Teams with Kubernetes expertise
- Applications requiring advanced networking
- Stateful applications needing persistent storage
- Multi-region deployments

❌ Not ideal for:

- Simple single-container applications
- Teams new to containers (steep learning curve!)
- Small projects with limited resources
- Quick prototypes or MVPs

AKS Architecture

Key Kubernetes Concepts:

Pods: Smallest unit - one or more containers running together

Services: Expose pods to network traffic

Deployments: Manage pod replicas and updates

Namespaces: Isolate resources within cluster

Ingress: HTTP routing to services

AKS Node Pools:

- Worker nodes that run your containers (Virtual Machines running Containers? We're really in the cloud now)
- Can have multiple pools with different VM sizes
- Automatically managed and patched by Azure

Components in practice

DNS

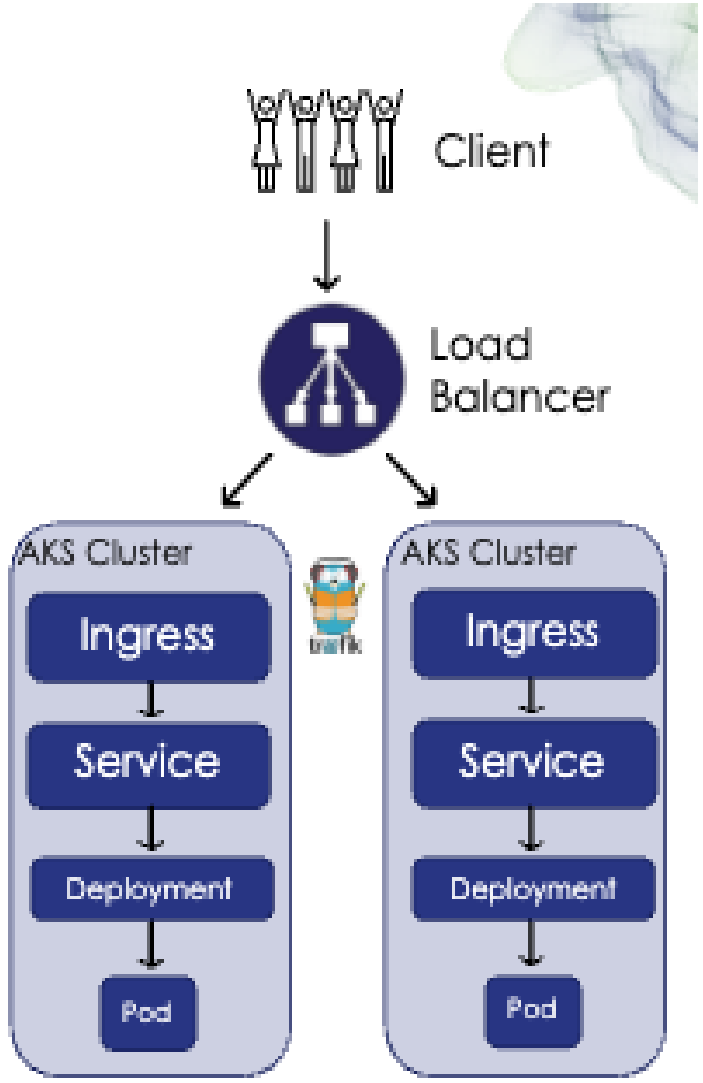
https://plum.platform.hmcts.net

```
[rees] [cft-prod-00-aks] ~/hmcts k get ingress -n cnp
Successfully parsed for: [delete, edit, uninstall], executing command in prod context...
NAME                    CLASS     HOSTS                      ADDRESS
plum-frontend-nodejs    traefik   plum.platform.hmcts.net    10.90.79.250
```

```
[rees] [cft-prod-00-aks] ~/hmcts k get svc -n cnp
Successfully parsed for: [delete, edit, uninstall], executing command in prod context
NAME                    TYPE        CLUSTER-IP     EXTERNAL-IP   PORT(S)   AGE
plum-frontend-nodejs    ClusterIP   10.0.198.133   <none>        80/TCP    45d
```

```
[rees] [cft-prod-00-aks] ~/hmcts kubectl get deployments -n cnp
Successfully parsed for: [delete, edit, uninstall], executing command in prod context
NAME                    READY   UP-TO-DATE   AVAILABLE   AGE
plum-frontend-nodejs    1/1     1            1           45d
```

```
[rees] [cft-prod-00-aks] ~/hmcts kubectl get pods -n cnp
Successfully parsed for: [delete, edit, uninstall], executing command in prod context...
NAME                                    READY   STATUS    RESTARTS   AGE
plum-frontend-nodejs-57c467875d-zzvv7   1/1     Running   0          11d
```



Real-World Scenarios

Which deployment option to use?

Scenario 1: Startup MVP

Context: Small team, limited budget, simple API, simple frontend?

Best choice: Azure Container Apps

- Quick to deploy
- Scales to zero when not in use
- Easy to add more services later
- No Kubernetes complexity

Scenario 2: Batch Data Processing

Context: Nightly data processing job, runs for 2 hours

Best choice: Azure Container Instances

- Spin up when needed
- Run job, then terminate
- Pay only for 2 hours
- No idle infrastructure costs

Scenario 3: Complex Microservices Platform

Context: 100+ microservices, dedicated DevOps team, multi-region

Best choice: Azure Kubernetes Service

- Can handle complexity
- Team has Kubernetes skills
- Need advanced networking
- Require custom operators and tools