# AKS Checklist

## Intent

As a Cloud Solution Architect, I work with many partners who want to migrate their application to Kubernetes and want a checklist of considerations.

The items listed here were inspired by my own findings as well as [The AKS Checklist](https://www.the-aks-checklist.com/).

## Cluster

* Use [AKS Managed AAD Integration](https://docs.microsoft.com/en-us/azure/aks/managed-aad)
* Limit cluster access via [K8S RBAC for users & workloads](https://docs.microsoft.com/en-us/azure/aks/azure-ad-rbac)
* Use [Managed Identity in AKS](https://docs.microsoft.com/en-us/azure/aks/use-managed-identity)
* Use [system node pools](https://docs.microsoft.com/en-us/azure/aks/use-system-pools)
* Use [kured](https://docs.microsoft.com/en-us/azure/aks/node-updates-kured) for security updates that need reboot
* Set [auto-upgrade channel](https://docs.microsoft.com/en-us/azure/aks/upgrade-cluster#set-auto-upgrade-channel)
* Prefer fewer, larger clusters over of many, smaller clusters
* Use [AKS API Server IP Whitelisting](https://docs.microsoft.com/en-us/azure/aks/api-server-authorized-ip-ranges)
* Use [AKS Private Cluster](https://docs.microsoft.com/en-us/azure/aks/private-clusters)
* Use [Managed Identity](https://docs.microsoft.com/en-us/azure/aks/use-managed-identity)
* Use [Proximity Placement Groups](https://docs.microsoft.com/en-us/azure/aks/reduce-latency-ppg)

## Container Image / Registry

* Use [ACR](https://docs.microsoft.com/en-us/azure/aks/cluster-container-registry-integration)
* Implement [Image Scanning](https://docs.microsoft.com/en-us/azure/security-center/defender-for-container-registries-introduction)
* Use only trusted images (e.g. only use images you created via CI/CD)
* Use [distroless images](https://github.com/GoogleContainerTools/distroless)
* Scan all container images against vulnerabilities
* Only use images from trusted container registries
  + Even better, only use a single ACR instance
* Use [least privilege RBAC](https://docs.microsoft.com/en-us/azure/container-registry/container-registry-roles) for your ACR
* Use [Private Endpoint / Private Link](https://docs.microsoft.com/en-us/azure/container-registry/container-registry-private-link)

## Security

* Read [The Definitive Guide to Securing Kubernetes](https://info.aquasec.com/securing_kubernetes) whitepaper
* Use a K8S security Product (e.g. Sysdig, AquaSec, Twistlock, etc.)
* Enable [Azure Defender for Kubernetes](https://docs.microsoft.com/en-us/azure/security-center/defender-for-kubernetes-introduction)
* Do not run containers as root or privileged
  + Example: allowPrivilegeEscalation: false
* Use [App Armor](https://docs.microsoft.com/en-us/azure/aks/operator-best-practices-cluster-security#app-armor) and [seccomp](https://docs.microsoft.com/en-us/azure/aks/operator-best-practices-cluster-security#secure-computing)

## Secrets

NOTE: By default, K8S Secrets are only encrypted at rest

* Understand [Secret Management in K8S](https://www.youtube.com/watch?v=KmhM33j5WYk&list=PLLasX02E8BPCrIhFrc_ZiINhbRkYMKdPT&index=11)
* Use [Azure Key Vault](https://docs.microsoft.com/en-us/azure/key-vault/general/key-vault-integrate-kubernetes) to store Secrets/Certificates
* Don’t inject secrets as environment vars (visible via kubectl describe)
* Don’t store secrets in container images
* Understand [AKS Quota and limits](https://docs.microsoft.com/en-us/azure/aks/quotas-skus-regions)

## Compute

* Set [resource quotas on namespaces](https://docs.microsoft.com/en-us/azure/aks/operator-best-practices-scheduler#enforce-resource-quotas)
* If necessary, [harden AKS agent nodes](https://clouddamcdnprodep.azureedge.net/gdc/gdc8LXmoZ/original)

## Availability

* Use [Uptime SLA](https://docs.microsoft.com/en-us/azure/aks/uptime-sla) for production clusters
  + NOTE: By Default K8S API does not have SLA. Only premium tier
* Configure [liveness and readiness probes](https://docs.microsoft.com/en-us/azure/application-gateway/ingress-controller-add-health-probes)
* Use Deployments and run at least 1 replica
* Configure [app logging, monitoring and alerting](https://docs.microsoft.com/en-us/azure/architecture/microservices/logging-monitoring)
* Enable exporting of [AKS Control Plane logs](https://docs.microsoft.com/en-us/azure/aks/view-control-plane-logs)
* Set [Pod Disruption Budgets](https://docs.microsoft.com/en-us/azure/aks/operator-best-practices-scheduler#plan-for-availability-using-pod-disruption-budgets) to prevent downtime during a planned disruption event
* Decide if [Availability Zones](https://docs.microsoft.com/en-us/azure/aks/availability-zones) or [multiple regions](https://docs.microsoft.com/en-us/azure/aks/operator-best-practices-multi-region) meet your needs

## Scaling

* Use [Pod Requests and Limits](https://docs.microsoft.com/en-us/azure/aks/developer-best-practices-resource-management#define-pod-resource-requests-and-limits)
* Use [Horizontal Pod Autoscaler](https://docs.microsoft.com/en-us/azure/aks/concepts-scale#horizontal-pod-autoscaler)
* Use [Cluster Autoscaling](https://docs.microsoft.com/en-us/azure/aks/cluster-autoscaler)

## Network

* Clearly understand your North-South and East-West network requirements
* Use a [Network Policy](https://docs.microsoft.com/en-us/azure/aks/use-network-policies) (Calico or Azure Network Policy)
  + Example: [Network Policy Recipes](https://github.com/ahmetb/kubernetes-network-policy-recipes)
* Use [Traffic Manager](https://azure.microsoft.com/en-us/services/traffic-manager/) or [Front Door](https://azure.microsoft.com/en-us/services/frontdoor/) to front traffic
* Only use [Internal Load Balancer](https://docs.microsoft.com/en-us/azure/aks/internal-lb)
* Use [Azure Firewall](https://docs.microsoft.com/en-us/azure/architecture/reference-architectures/containers/aks/secure-baseline-aks#egress-traffic-flow) to inspect egress traffic for data leakage.
* Use [Ingress Controller](https://docs.microsoft.com/en-us/azure/aks/ingress-basic)
* Use a [WAF](https://azure.microsoft.com/en-us/services/web-application-firewall/)
  + Examples: [AppGW](https://docs.microsoft.com/en-us/azure/web-application-firewall/ag/ag-overview), [Front Door](https://docs.microsoft.com/en-us/azure/web-application-firewall/afds/afds-overview), [Nginx+](https://docs.nginx.com/nginx-waf/)

## Governance

* Use [Azure Policy for Kubernetes](https://docs.microsoft.com/en-us/azure/aks/use-azure-policy)
  + Example: [AKS Policy Refernce](https://docs.microsoft.com/en-us/azure/aks/policy-reference)

## Service Mesh

* Don’t use a service mesh unless you have a specific need

## Business Continuity / Multi-Region

AKS cluster is a region-based service. To enable availability in multiple regions, you will need to deploy a new AKS instance in each desired region.

* Use [Azure Paired Regions](https://docs.microsoft.com/en-us/azure/best-practices-availability-paired-regions)
* Enable [ACR Geo-replication](https://docs.microsoft.com/en-us/azure/container-registry/container-registry-geo-replication)

## Deployment

* Use [GitOps](https://www.weave.works/technologies/gitops/)
* Don’t use the default namespace

## Multi-Tenancy

* Some tenants can be in shared env; Some tenants might be big enough to require separate cluster
* Namespace does NOT provide any isolation, but is a common practice for grouping tenants
* Use Helm or CRD to package new tenants

## Storage

Stateless processes are easier to be operate, scale and tolerate failure. We recommend using PaaS services; however, sometimes storing state inside the container is unavoidable and you must use storage into the container.

* Understand [AKS](https://docs.microsoft.com/en-us/azure/aks/concepts-storage) and [K8S](https://kubernetes.io/docs/concepts/storage/persistent-volumes/) storage concepts
* Pick the right [Storage Class](https://docs.microsoft.com/en-us/azure/aks/concepts-storage#storage-classes)
* Use [PVC](https://docs.microsoft.com/en-us/azure/aks/azure-disks-dynamic-pv) instead of a [PV](https://docs.microsoft.com/en-us/azure/aks/azure-disk-volume)
* Use [Velero](https://velero.io/), [Portworx](https://docs.portworx.com/portworx-install-with-kubernetes/cloud/azure/aks/) or [Kasten](https://www.kasten.io/) for Backup and Multi-region resiliency.

## Tooling

* [Helm](https://helm.sh/)
* [Flux - GitOps](https://toolkit.fluxcd.io/)
* [Kubectl aliases](https://github.com/ahmetb/kubectl-aliases)
* [kubectx](https://github.com/ahmetb/kubectx)
* [k9s](https://k9scli.io/)

References:

* [AKS Cluster Security Best Practices](https://docs.microsoft.com/en-us/azure/aks/operator-best-practices-cluster-security)
* [Cloud Adoption Framework - Kubernetes](https://docs.microsoft.com/en-us/azure/cloud-adoption-framework/innovate/kubernetes/)
* [Azure Defender for Kubernetes](https://docs.microsoft.com/en-us/azure/security-center/defender-for-kubernetes-introduction)
* [We use the term ‘hostile multitenancy’ in Microsoft to describe hosting platforms that must provide strict resource governance and security isolation between different customers. ‘Enterprise multitenancy’ assumes internal customers with good intent and reactive controls – Mark Russinovich](https://twitter.com/markrussinovich/status/1363988454485368832)