

Mastering Azure Availability Zones

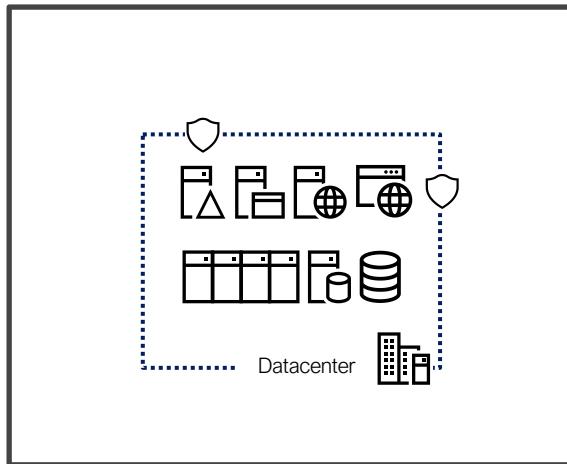
Jan Egil Ring
Crayon

Agenda

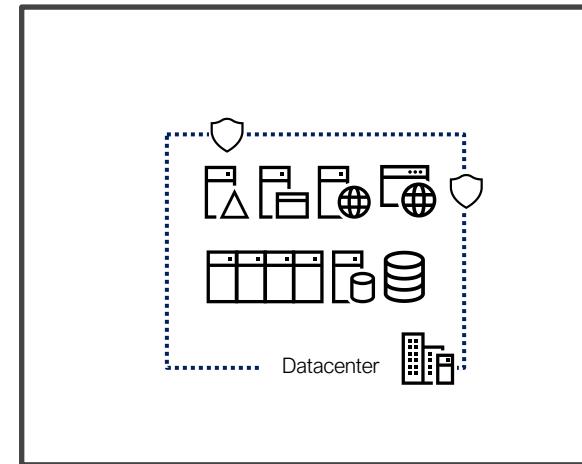
- Azure datacenters in Norway
- Availability Zones overview
- Demos
- Experiences from Norwegian customers

Norwegian datacenters – initial release 2019

Norway West



Norway East



Microsoft dobler investeringen: Bygger to nye norske datasentre

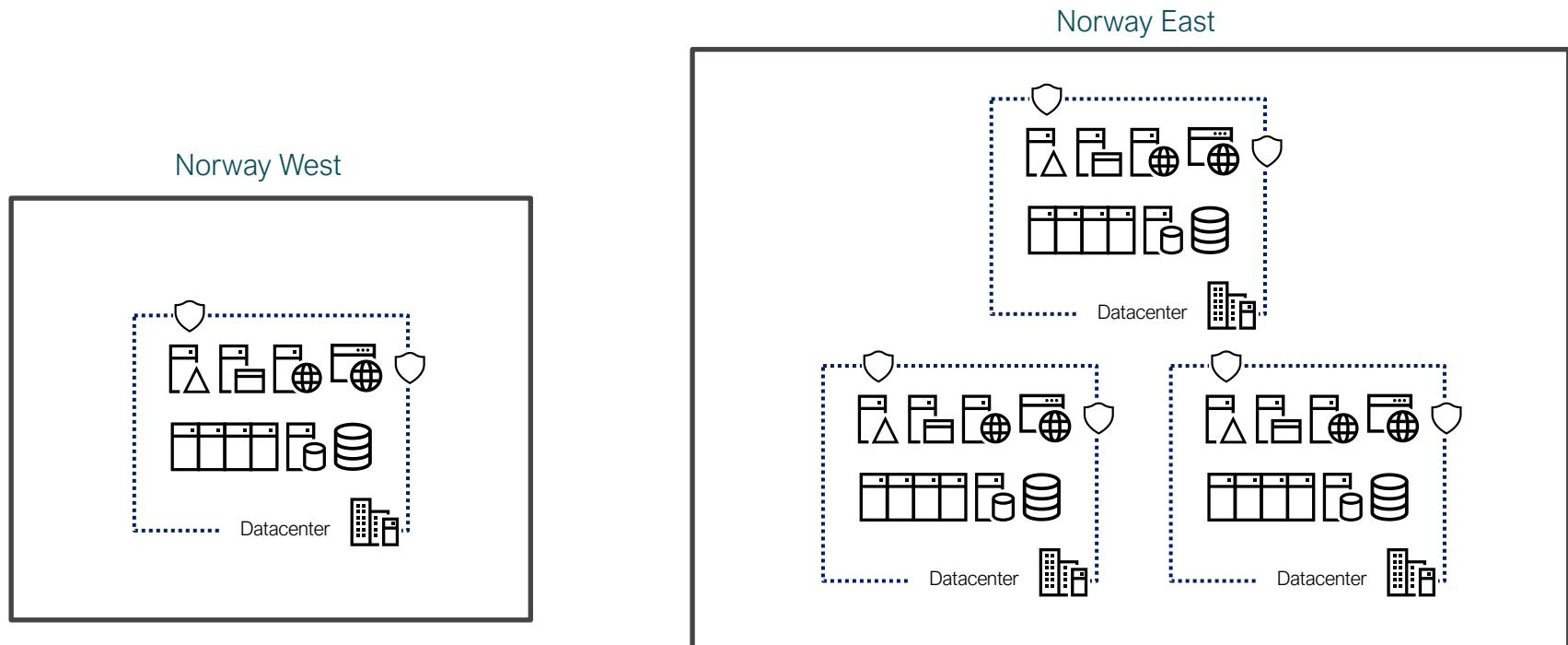
En Equinor-kontrakt fikk Microsoft til å begynne datasenterbygging i Norge. Nå dobler den amerikanske giganten innsatsen takket være stor pågang fra norske bedrifter.

Publisert 28. sep. 2021 kl. 14.00

🕒 Lesetid: 3 minutter



Norwegian datacenters – extended fall 2021



99.998%

Azure VM uptime, rolling 12-month average

Building reliable systems is a shared responsibility

Your application

Your **app or workload** architecture, built on the below.

Resiliency features

Optional Azure capabilities **you enable as needed** – high availability, disaster recovery, and backup.

Resilient foundation

Core Azure capabilities **built into the platform** – how the foundation is designed, operated, and monitored to ensure availability.

Complex systems need resilience to deliver reliability



Reliability

Reliability is the ‘what’.

It is the goal for production systems, to ensure availability of their services.

You want to maintain reliable systems, with the appropriate level of availability/uptime.



Resilience

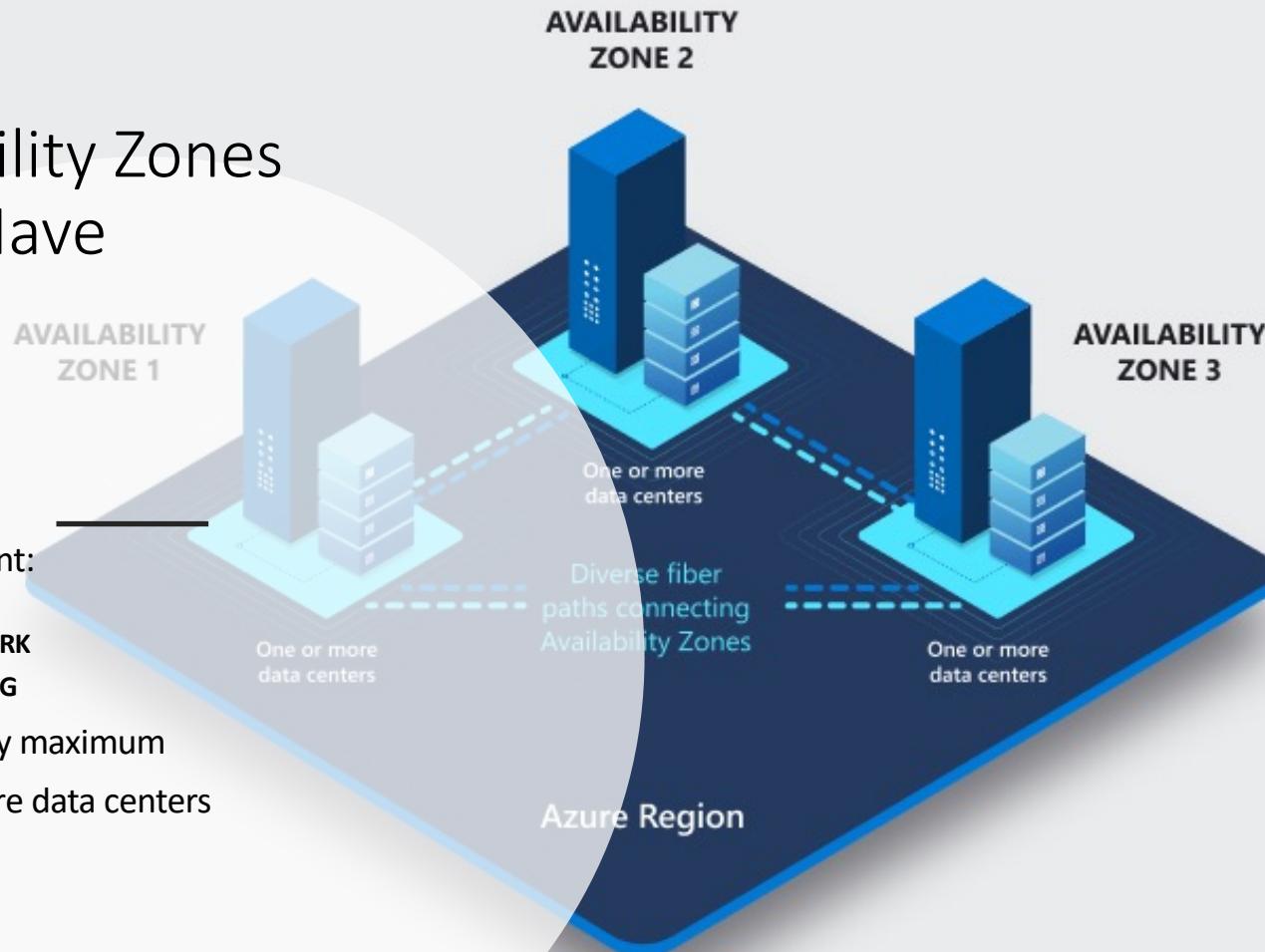
Resilience is the ‘how’.

It is the way in which production systems can achieve reliability.

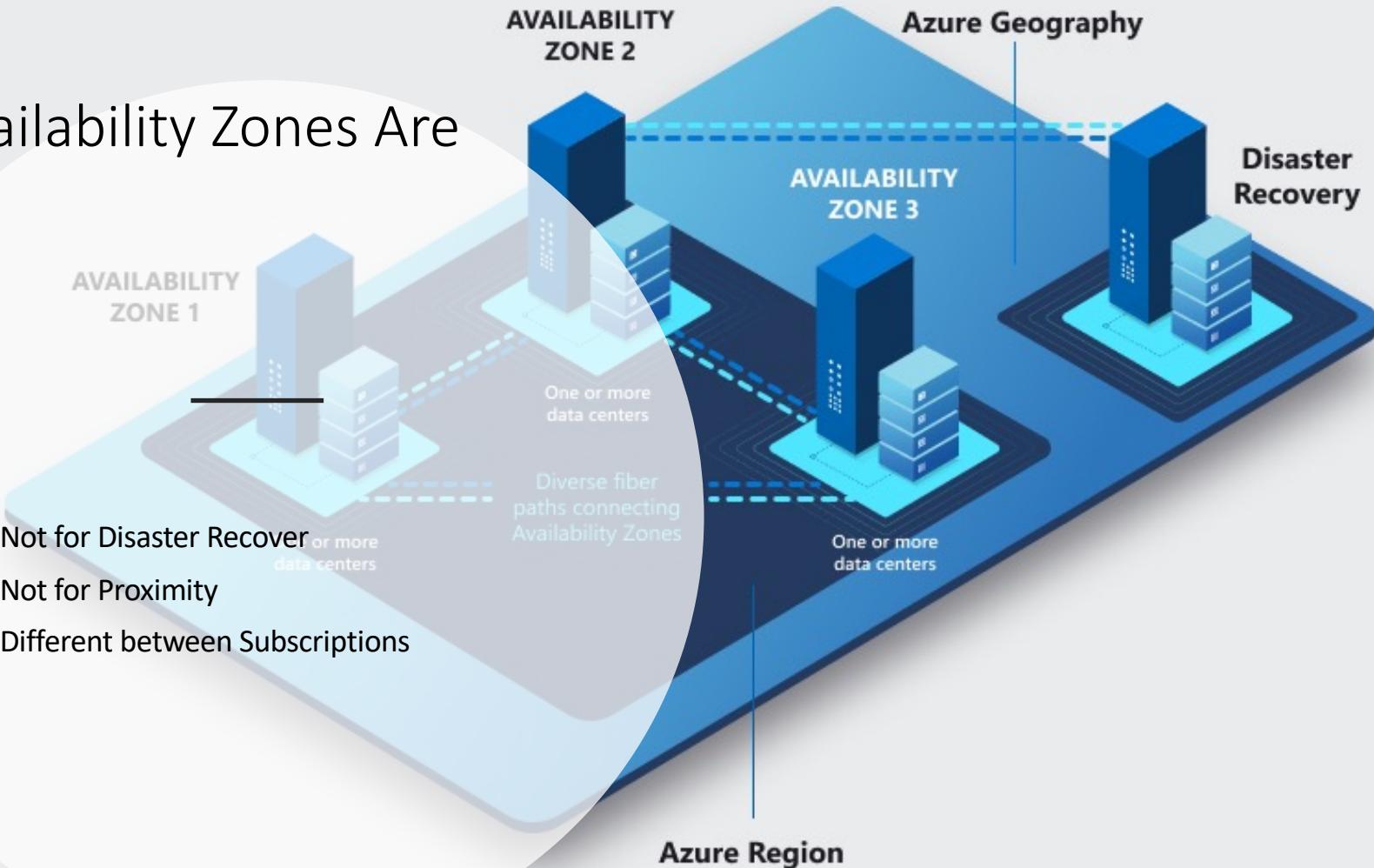
The objective is not to avoid any and all failures – it is to respond to failure in a way that avoids downtime and data loss.

Availability Zones Have

- Independent:
 - POWER
 - NETWORK
 - COOLING
- 2ms latency maximum
- One or more data centers



Availability Zones Are



Protection through redundancy

Avoid single points of failure for business continuity



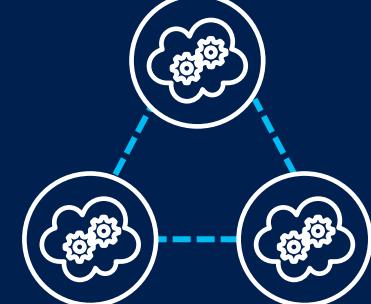
Minimum of three physically separated locations

Three Availability Zones to support quorum based workloads like SQL, Service Fabric, Cassandra, MongoDB.



Independent power, cooling, network

A facility level failure or single fiber path failure will affect only one zone.



Azure management services replicated across zones

Azure management services are redundant, so a single zone failure will not affect other zones. Azure maintenance orchestrated zone by zone.

Virtual Machines 1/2



- foundational zonal service
- you pin VMs to one of the zones
- VMs deployed before AZs were available are **regional (non-zonal)**
- Availability Sets do not span zones
- moving from AS to AZ configuration: 99.95% → 99.99% SLA
- **new deployment with zonal config** is the easiest option (mainly for stateless workloads)
 - Infrastructure as Code practice

[main.bicep](#)

```
resource symbolicname 'Microsoft.Compute/virtualMachines@2021-04-01' = {  
    name: 'string'  
    location: 'string'  
    zones: ['string']}
```



Demo



- Provisioning VMs into Availability Zones
 - Portal
 - CLI
 - Infrastructure as Code
 - Bicep
 - Terraform
- Enable replication between Availability Zones for singleton VMs

Virtual Machines 2/2



- **alternative** – Private Preview that will allow “move” from regional to zonal config in the same region (under NDA)
 - Resource Mover doesn’t support this scenario
 - Contact your me or your Microsoft account team to be onboarded to the Preview
- **singletons** – zone-to-zone replication (ASR) is the only benefit of moving to zonal config



Reliable Architecture using Availability Zones

Use Zone-Redundant Services

- Standard Load balancer
- Standard Public IP
- VM Scale Sets with Zone settings
- Azure SQL
- Cosmos DB
- Service Bus
- Zone Redundant Storage
- ...

Avoid Single Point of Failure

Redeploy in Zone-Redundant Configuration

Service Level Agreements, Recovery Time

Create realistic requirements on uptime and recovery objectives

Calculate based on current design

Evaluate changes – revisit requirements

Find balance!

Stateful vs Stateless Applications

Increase Resilience, Lower Recovery Time

Azure Site Recovery supports Zones

Zone Redundant Storage

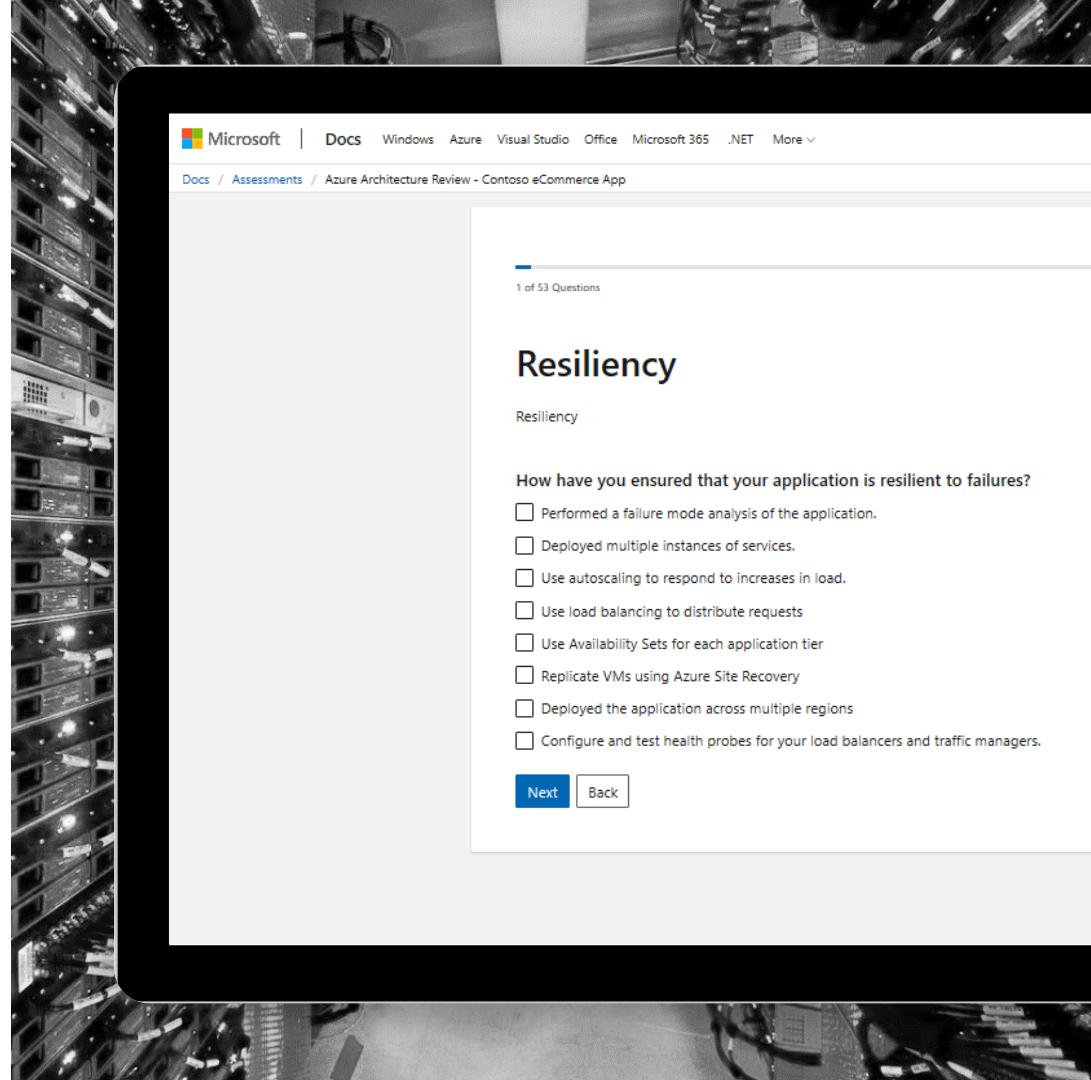
Backups are still necessary

Track Azure Scheduled Events

Microsoft Azure Architecture Review

The Azure **Well-Architected Framework** and the associated Azure Architecture Assessment are tools for customers to optimize their workloads across the five pillars—Cost, DevOps, Scalability, **Resiliency**, and Security.

aka.ms/ArchitectureReview

The background of the slide features a dark, high-angle photograph of a server rack filled with numerous glowing hard drives or components. In the foreground, a white Microsoft Edge browser window is displayed, showing a screenshot of the Azure Architecture Review tool. The browser's address bar shows 'Docs / Assessments / Azure Architecture Review - Contoso eCommerce App'. The main content area is titled 'Resiliency' and contains the question 'How have you ensured that your application is resilient to failures?'. Below the question is a list of eight checkboxes, each representing a best practice for resiliency. At the bottom right of the browser window are 'Next' and 'Back' buttons.

Microsoft | Docs Windows Azure Visual Studio Office Microsoft 365 .NET More ▾

Docs / Assessments / Azure Architecture Review - Contoso eCommerce App

1 of 53 Questions

Resiliency

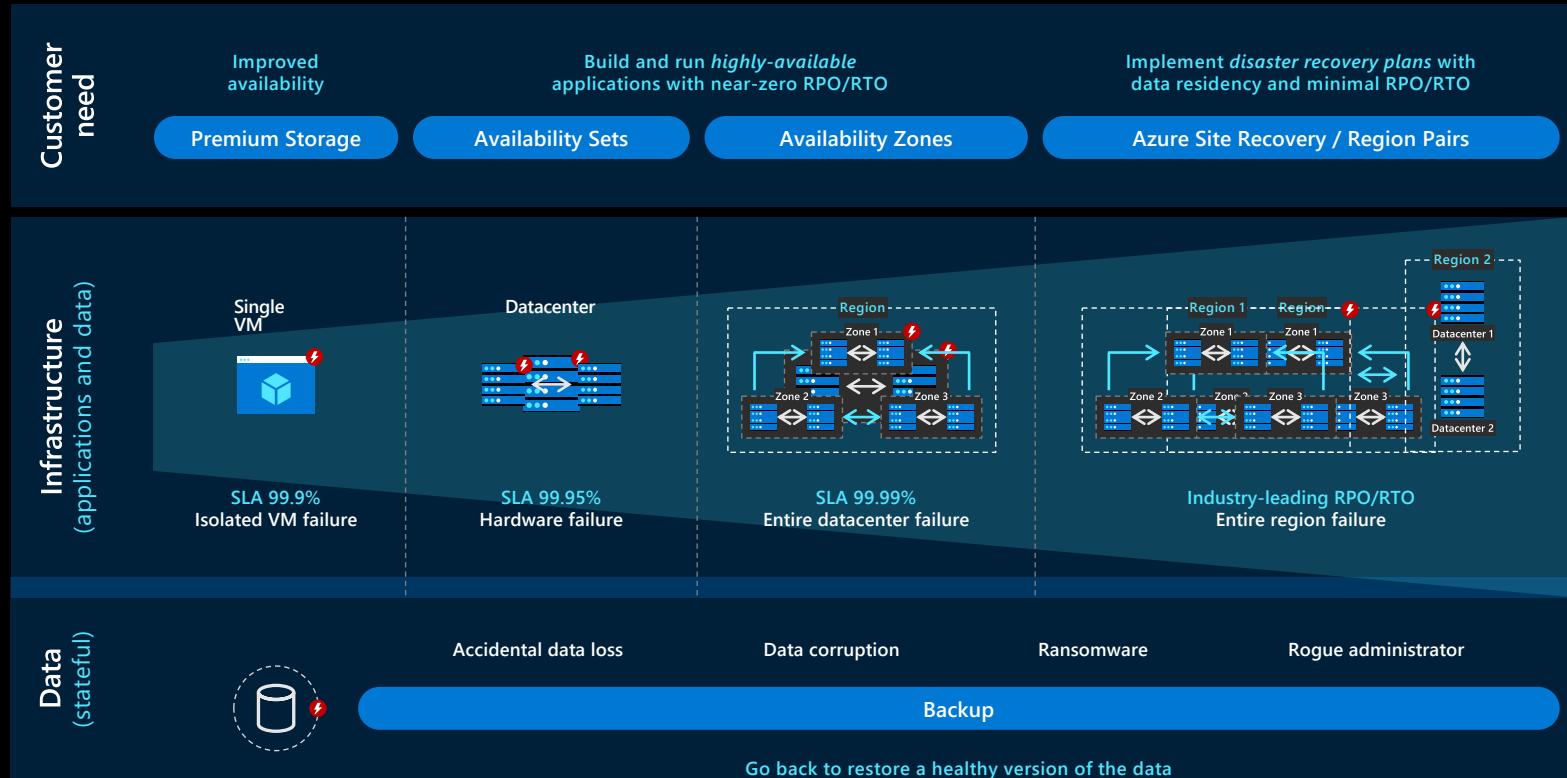
Resiliency

How have you ensured that your application is resilient to failures?

- Performed a failure mode analysis of the application.
- Deployed multiple instances of services.
- Use autoscaling to respond to increases in load.
- Use load balancing to distribute requests
- Use Availability Sets for each application tier
- Replicate VMs using Azure Site Recovery
- Deployed the application across multiple regions
- Configure and test health probes for your load balancers and traffic managers.

Next Back

Reliability



Azure service categories



Foundational services

Available in all recommended and alternate regions when a region is GA, or within 90 days of a new foundational service becoming GA.



Mainstream services

Available in all recommended regions within 90 days of a region's GA. Mainstream services are demand-driven in alternate regions, and many are already deployed into a large subset of alternate regions.



Strategic services

Targeted service offerings, often industry-focused or backed by customized hardware. Strategic services are demand-driven for availability across regions, and many are already deployed into a large subset of recommended regions.



Ultra

Azure service types supporting AZs



Zonal services

- deployed to a specific, self-selected AZ to achieve latency or performance requirements
- self-architected resiliency - replicate applications and data to one or more zones within the region
- resources can be pinned to a specific zone

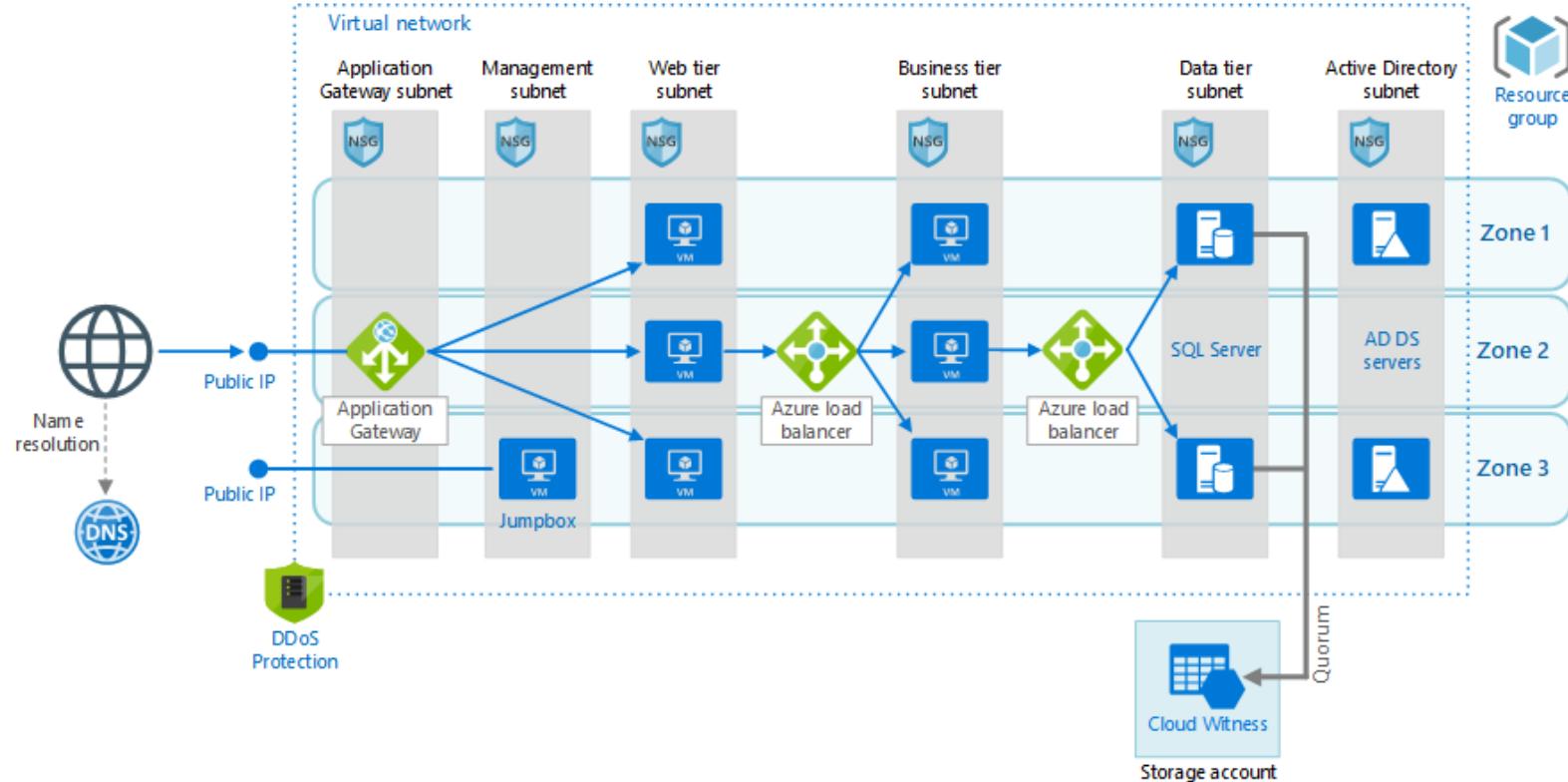
Zone-redundant services

- resources are replicated or distributed across zones automatically
- failure in one zone doesn't affect the high availability of the data

Always-available services (non-regional)

- always available across all Azure geographies and are resilient to zone-wide outages and region-wide outages

Example: resilient N-tier application



Public IP address



- foundational zone-redundant (or zonal) service

SKU Name

- Standard or Basic
- Standard support zone-redundancy

SKU tier

- Regional
- Global – for cross-region services like Global Load Balancer (in Preview)
- zone configuration for Standard Regional PIP
 - Zone-redundant
 - Specific zone (one)



Azure Load Balancer



- foundational zone-redundant (or zonal) service

SKU name

- Basic, Standard, Gateway
- only Standard SKU provides zone resiliency

SKU tier

- Regional
- Global (in Preview) – cross-region global load balancer using regional load balancers as backends
- zone configuration is not exposed as resource property directly, it is determined by SKU!



Application Gateway (v2)



- foundational zone-redundant (or zonal) service

SKU Name

- Standard_v2, WAF_v2 (+ "V1" SKUs)

SKU tier

- Standard_v2 and WAF_v2 support zones (Standard and WAF do not)
- zone configuration: None or a multi-select option
 - it is recommended to select several zones for HA - removes the need to provision separate Application Gateway instances in each zone with a Traffic Manager
- *Remember to distribute the backend pool across zones too!*



Azure Storage



Locally-Redundant (LRS)

- three copies within a single datacenter

Zone-redundant (ZRS)

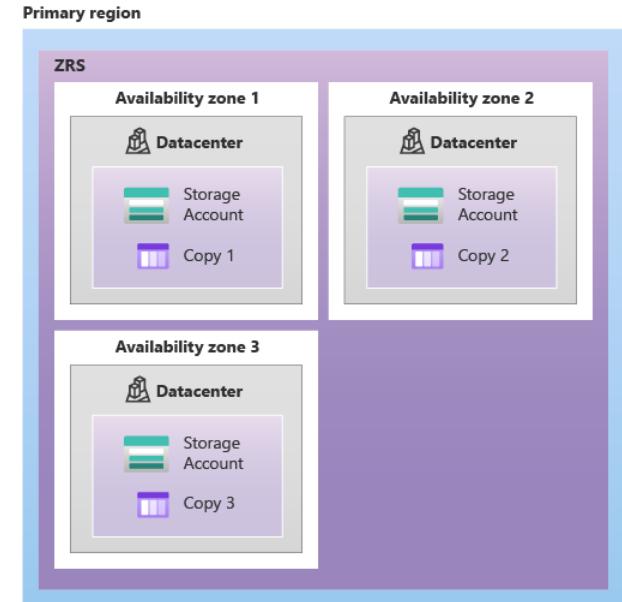
- three copies spread across three zones

Geo-redundant (GRS)

- three copies in one datacenter in primary region + three copies in one datacenter in secondary

Geo-zone-redundant (GZRS)

- three copies spread across three zones in primary region + three copies in one datacenter in secondary
- GRS and GZRS can also have R/O access to secondary region
- Norway East region supports all options



Azure Storage cont.



- Premium account type only supports LRS
- LRS can only be reconfigured to GRS, or RA-GRS → **no option to “convert”** your existing storage account to zone-redundant variant
 - Consider creating a new ZRS (GZRS) account and copy data between accounts using [AzCopy](#) or another tool
 - Support case for “large” storage accounts – backend conversion

Copy containers, directories, and blobs

Copy all containers, directories, and blobs to another storage account by using the `azcopy copy` command.

Tip

This example encloses path arguments with single quotes (''). Use single quotes in all command shells except for the Windows Command Shell (cmd.exe). If you're using a Windows Command Shell (cmd.exe), enclose path arguments with double quotes ("") instead of single quotes ('').

Syntax

```
azcopy copy 'https://<source-storage-account-name>.blob.core.windows.net/<SAS-token>' 'https://<destination-storage-account-name>.blob.core.windows.net/' --recursive
```





TINE

Customer:
TINE SA

Industry:
Manufacturing

Size:
1,000–9,999 employees

Country:
Norway

Products and services:
Microsoft Azure
Azure ExpressRoute
Azure Migration Program
Azure Red Hat OpenShift
Microsoft FastTrack for Azure

[Read full story here](#)



"With physical servers, we always had to make sure the firmware matched the drivers on the server, that we had the right network adapter, and that everything fit together. With Azure, you don't have to think about that."

—Morten Hansen, Infrastructure Architect, TINE

Situation:

TINE, Norway's largest producer, distributor, and exporter of dairy products, felt it spent too much money and time on buying, configuring, and maintaining its dated, on-premises infrastructure.

Solution:

With the help of Microsoft Partner Network member Crayon and the Microsoft Azure Migration Program, TINE now has a hybrid platform that supports both on-premises and new cloud-native apps and services.

Impact:

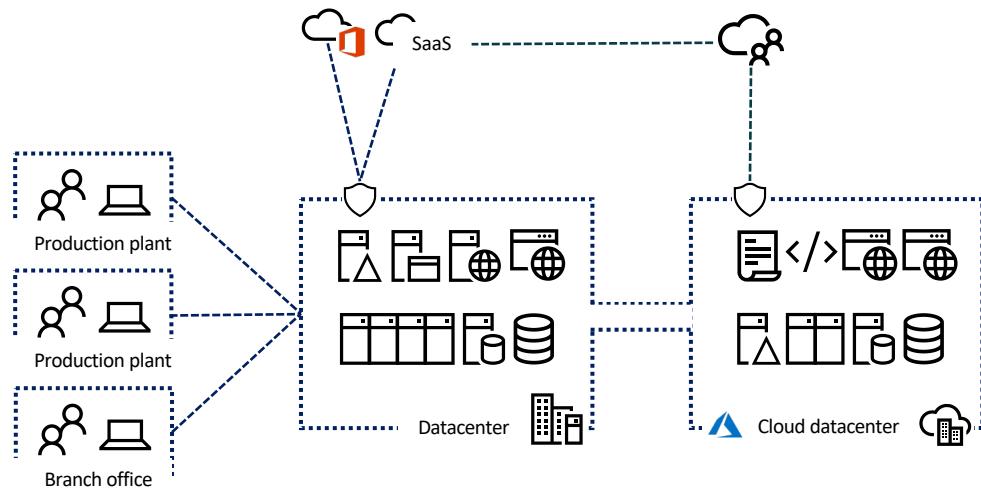
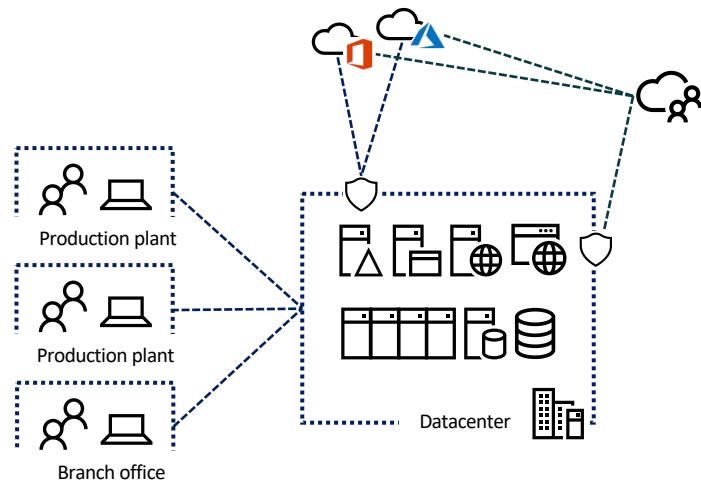
TINE is gradually shifting more and more workloads to the cloud and now can purchase managed services. After participating in the program and moving to Azure, TINE is easily reducing costs, modernizing its infrastructure, and improving operations.



TINE Meieriet Jæren

TINE Meieriet Jæren ligger i Kviamarka i Hå kommune. Meieriet er eit moderne anlegg med produksjon av hvitost, prim, smør, margarin og pulver basert på myse. Anlegget mottar 210 millioner liter melk per år, og produserer ca. 46 000 tonn ferdigvarer. Antall ansatte ved anlegget er 170

Modernization – hybrid datacenter



E-commerce platform – tinehandel.no

The screenshot shows the homepage of the tinehandel.no website. At the top, there is a navigation bar with the TINE logo, a search bar with a magnifying glass icon, a menu button, and a shopping cart icon. Below the navigation bar, there is a blue header section with fields for 'Kundenummer/Brukernavn', 'Husk meg', 'Passord', and 'Glemt passord?'. There are also 'Logg inn' and 'Ny kunde?' buttons. The main content area features a large blue banner with the text 'Hvordan starte opp servering igjen på en trygg måte?'. To the left of this text is a paragraph about starting up again safely. To the right of the text is a collage of four images: a woman smiling with a yellow cup, a red smoothie with blueberries, a sandwich, and a hand holding a drink. Below this collage are navigation arrows. At the bottom, there are three categories: 'PRODUKTER' with a milk icon, 'PRODUKTNYHETER' with a milk icon and a yellow starburst, and 'UTGÅTTE PRODUKTER' with a crossed-out milk icon.

Hvordan starte opp servering igjen på en trygg måte?

Når du og din bedrift starter forsiktig opp igjen, er det antagelig usikkert om det blir som før – i alle fall for en periode. TINE Partner gir deg tips, enkle løsninger og produkter som er ekstra hygieniske.

Kundenummer/Brukernavn: Husk meg Passord: Glemt passord?

Legg inn brukernavn Logg inn Ny kunde?

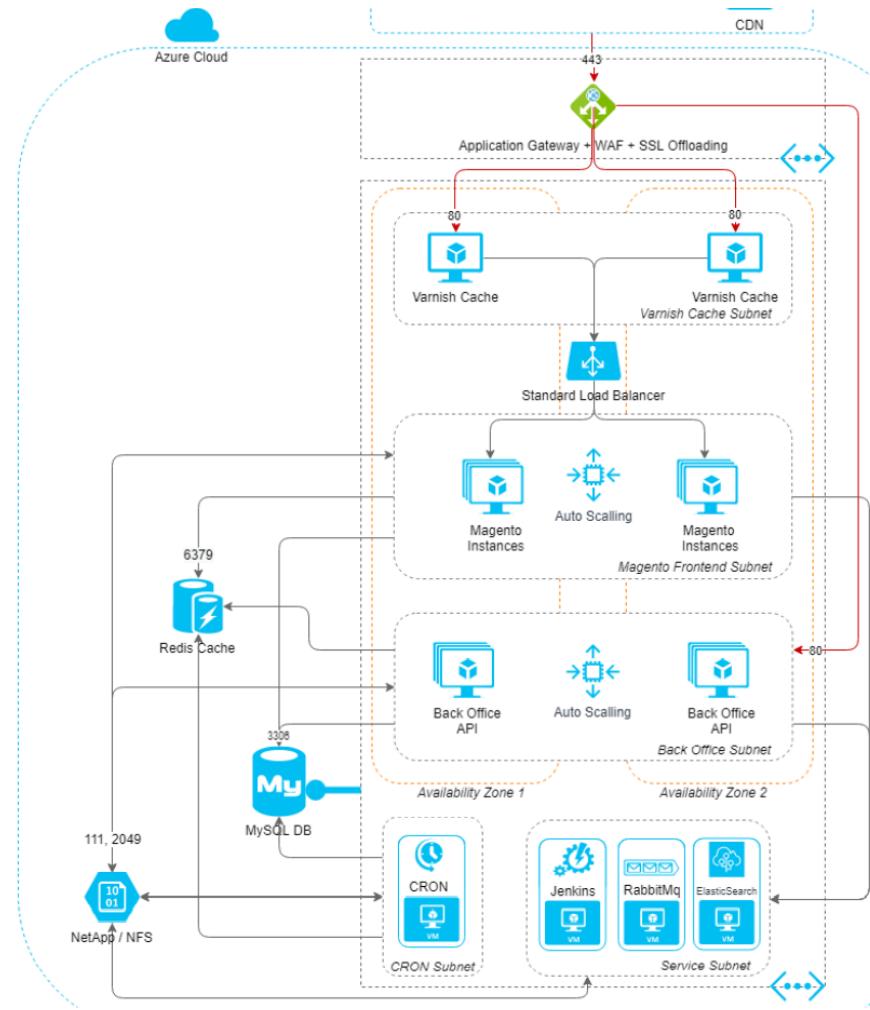
PRODUKTER

PRODUKTNYHETER

UTGÅTTE PRODUKTER

Infrastructure

tinehandel.no



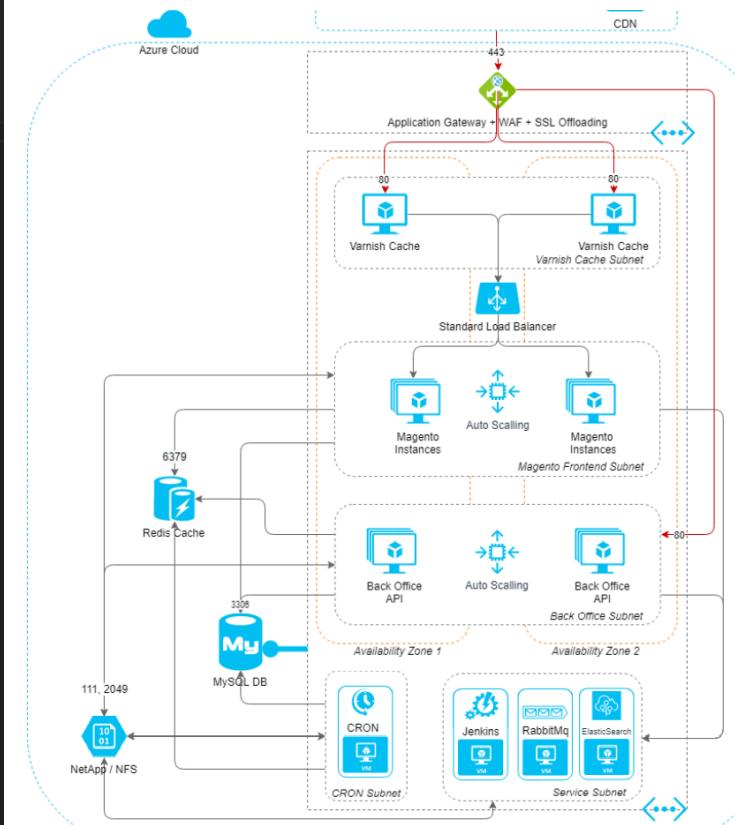
tine-terraform-dsp-instance

main / virtual_machines.tf

virtual_machines.tf

Contents History Compare Blame

```
1 module "virtual_machines" {
2     for_each = { for vm in var.virtual_machines : vm.name => vm }
3     source   = "crayon/vm/azurerm"
4     version  = "1.9.0"
5
6     name        = each.value.name
7     resource_group = azurerm_resource_group.rg.name
8     location    = "norwayeast"
9     tags        = var.tags
10
11     vm_size = each.value.vm_size
12
13     source_image_id = each.value.source_image_id
14
15     os_disk = {
16         caching          = "ReadWrite"
17         storage_account_type = "StandardSSD_LRS"
18         optional_settings  = {}
19     }
20
21     admin_user = {
22         username =
23         password = random_password.vm-password[each.value.name].result
24     }
25
26     network_interface_subnets = [
27         name        = each.value.subnet_name
28         virtual_network_name = var.virtual_network_name
29         resource_group_name = var.virtual_network_resource_group_name
30         public_ip_id       = null
31     ]
32
33     data_disks = each.value.data_disks
34
35     managed_boot_diagnostic = true
36
37     availability_set_id = azurerm_availability_set.dsp.id
38 }
```



Latency – basic test

The screenshot displays three separate Azure Virtual Machine (VM) management interfaces side-by-side, each showing the 'Overview' page for a different VM.

- tstaz01:** Located in the 'Resource group' [REDACTED].
 - Instance details:** Virtual machine name: **tstaz01**, Region: [REDACTED], Availability options: [REDACTED], Availability zone: [REDACTED], Image: [REDACTED], Azure Spot instance: [REDACTED], Administrator account: [REDACTED].
 - Actions:** Connect, Start, Restart, Stop, Capture, Delete.
 - Essentials:** Resource group (change) : [REDACTED], Status : Running, Location : Norway East (Zone 3), Subscription (change) : [REDACTED], Subscription ID : [REDACTED], Availability zone : 3.
- tstaz02:** Located in the 'Resource group' [REDACTED].
 - Instance details:** Virtual machine name: **tstaz02**, Region: [REDACTED], Availability options: [REDACTED], Availability zone: [REDACTED], Image: [REDACTED], Azure Spot instance: [REDACTED], Administrator account: [REDACTED].
 - Actions:** Connect, Start, Restart, Stop, Capture, Delete.
 - Essentials:** Resource group (change) : [REDACTED], Status : Running, Location : Norway East (Zone 3), Subscription (change) : [REDACTED], Subscription ID : [REDACTED], Availability zone : 3.
- tstaz03:** Located in the 'Resource group' [REDACTED].
 - Instance details:** Virtual machine name: **tstaz03**, Region: [REDACTED], Availability options: [REDACTED], Availability zone: [REDACTED], Image: [REDACTED], Azure Spot instance: [REDACTED], Administrator account: [REDACTED].
 - Actions:** Connect, Start, Restart, Stop, Capture, Delete.
 - Essentials:** Resource group (change) : [REDACTED], Status : Running, Location : Norway East (Zone 3), Subscription (change) : [REDACTED], Subscription ID : [REDACTED], Availability zone : 3.

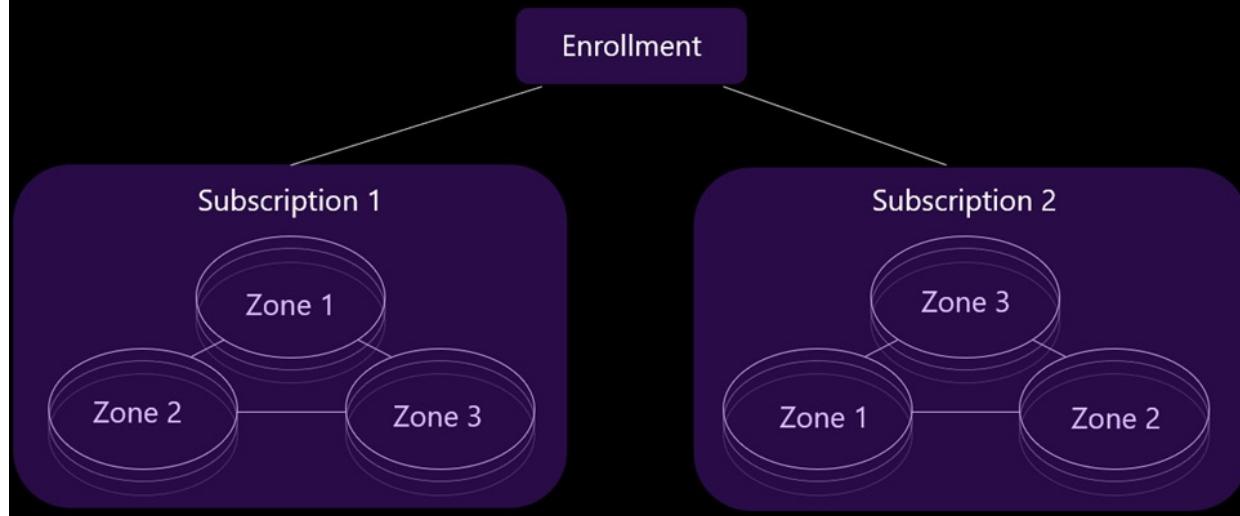
Demo



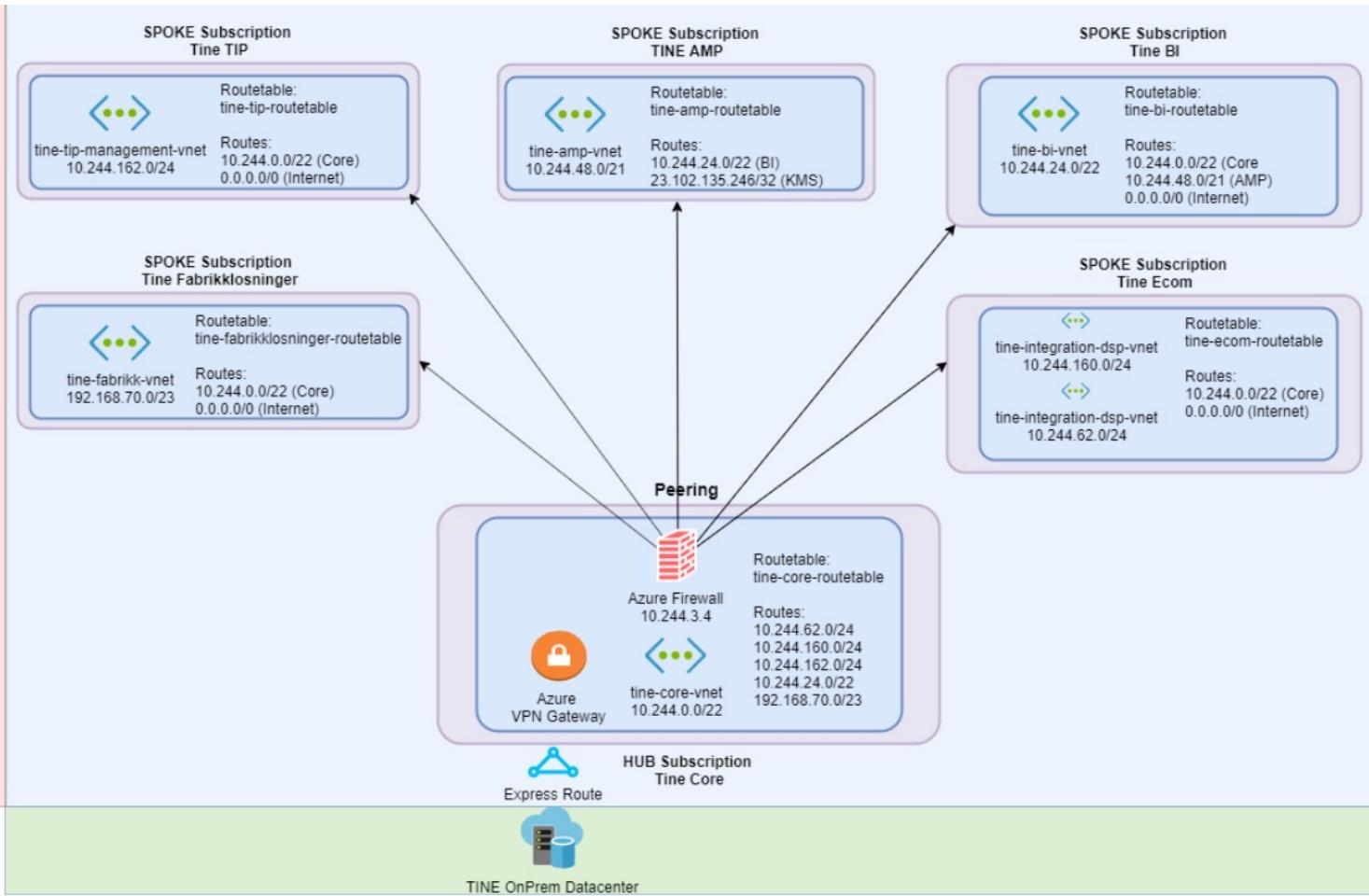
- How to check zone assignments using PowerShell

Zone Assignment

Upon Subscription activation – the physical DC to zone mapping is created randomly
Query API to get mapping: [Subscriptions - Check Zone Peers - REST API](#)



TINE Azure Network



Azure Firewall

- Delete existing firewall in a maintenance window
- Provision new firewall with AZ SKU
 - Option 1: Backup existing ARM-definition of deployed instance, enable AZ and re-deploy template
 - Option 2: Re-deploy Infrastructure as Code (ARM/Bicep/Terraform/others) configuration with AZ enabled

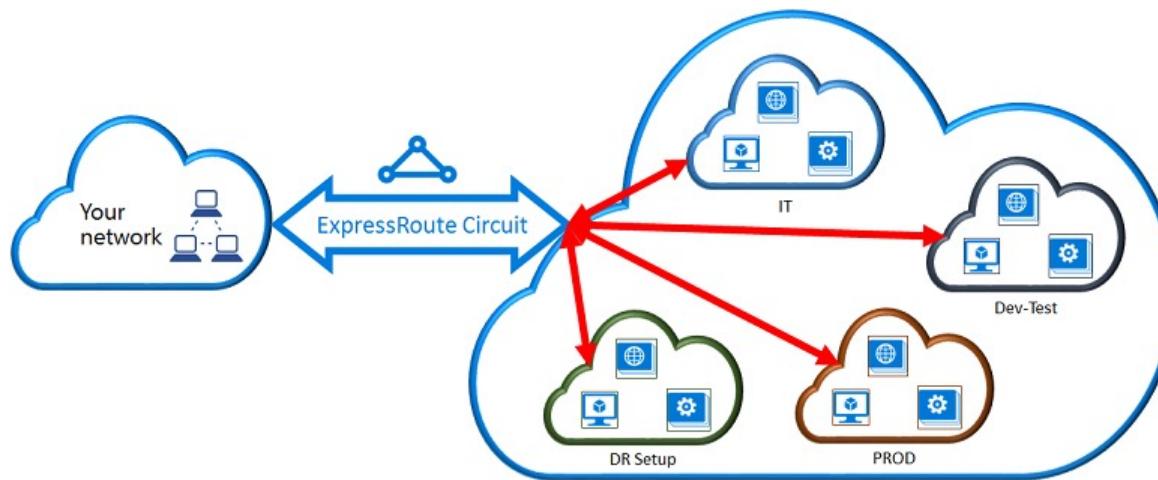
Demo



- How to redeploy Azure Firewall into zone-redundant configuration



Azure ExpressRoute – Availability Zone redundancy



Same procedure as for Azure Firewall, you will need to delete your existing gateway and re-create a zone-redundant or zonal gateway.

<https://docs.microsoft.com/en-us/azure/expressroute/expressroute-about-virtual-network-gateways>

Call to action at Tine

- Establish AZ-redundancy on foundational services
 - Azure Firewall
 - ExpressRoute Gateway
 - Move domain controllers in Azure from Availability Sets to Availability Zones
 - Trade-off: Consider effort of migrating existing DCs vs deploy new ones (can potentially lift OS version as well)
- Evaluate existing workloads against SLA-requirements
 - Tine Kumulus (Data platform) – mostly PaaS
 - Tine DSP (Tinehandel, e-commerce) – redeploy using IaC
 - Tine ERP (Infor M3) – mostly IaaS
 - Tine TIP (Integration platform on top of RedHat OpenShift, consider ARO)
 - Tine AMP - “singleton” services, consider Site Recovery using zone-to-zone replication
 - Consider Availability Zones for new projects & workloads

FIRESAFE /



Closing

- Norway have 4 DCs and 2 regions
- Use availability zones for mission critical workloads
 - Not a replacement for backups
- Azure Well Architected framework

Announcement

Whitepaper – «Sky i offentlig sektor»

- Initially created by individuals in Microsoft and partners
- Now open source on GitHub for everyone to consume and contribute to
- Content
 - Reference architectures for public sector (initially for municipalities)
 - Blueprints/templates
 - Whitepaper (PDF/web)

<https://aka.ms/sky-i-offentlig>

URL will also be shared via **@JanEgilRing** on Twitter

Resources

- Availability Zones documentation
 - Overview over regions and services with AZ support
 - <https://docs.microsoft.com/en-us/azure/availability-zones/az-overview>
- Well Architected Framework
 - <https://docs.microsoft.com/en-us/azure/architecture/framework/>
- Chaos Engineering
 - <https://docs.microsoft.com/en-us/azure/architecture/framework/resiliency/chaos-engineering>

Slides and demos from the conference will be available at

<https://github.com/nordicinfrastructureconference/2022>

URL will also be shared via **@JanEgilRing** on Twitter