

Week 3 :

Prepare R&D Document on Azure Global Infrastructure such as Geographies, Azure Regions, Availability Zones, Data Centers

Azure Global Infrastructure

Microsoft Azure's global infrastructure is a vast, worldwide network of datacenter regions, fault domains, and connectivity. Azure spans **60+ regions** in over 140 countries, more than any other cloud provider. Each *region* is a set of one or more datacenter facilities in a metro area, connected by high-capacity, low-latency networks. These regions are organized into broader *geographies* (fixed data-residency boundaries) so that all data stays within specified legal/policy boundaries. For example, the "United States" geography contains East US, Central US, etc.; "Europe" contains West Europe, North Europe, UK, etc.; "Asia Pacific" contains Southeast Asia, East Asia, India, etc.; and there are distinct geographies for sovereign clouds like Azure Government (US) and Azure operated by 21Vianet (China). This global footprint ensures local performance (low latency) and compliance, and it includes **over 100 highly secure datacenter facilities** worldwide.

Azure regions are grouped by geography, and each region may contain multiple *Availability Zones* and a paired region. In the diagram above, **Region 1** has three zones (AZ1–3) and a paired **Region 2** (all within the same geography/data boundary). **Region 3** and **Region 4** (in another geography) have no zone topology. Azure ensures fault tolerance by using both *zone redundancy* and *paired regions*. Each geography is fault-tolerant: if one region fails, the paired or zoned backups in that geography can take over.

Azure Geographies

An **Azure geography** is a grouping of regions within a specific geopolitical boundary, designed for compliance and data residency. For example, **United States** is an Azure geography, as is **Europe**, **Asia Pacific**, **Brazil**, **South Africa**, etc.. Each geography contains one or more regions and ensures data sovereignty (your data remains in that area). Geographies are inherently resilient across regions: the high-speed network linking all regions in a geography helps withstand even a complete regional outage. Notably, some geographies are **sovereign clouds** with extra compliance: Azure Government (US federal/state) and Azure operated by 21Vianet (China) are separate geographies, each with dedicated regions and limited service availability.

Geography	Example Regions
Americas (US, Canada, LatAm)	East US, West US, Central US, Canada East, Brazil South, Chile Central
Europe	West Europe, North Europe, UK South, France Central, Germany West
Asia Pacific	Southeast Asia, East Asia, Japan East, Korea Central, India Central
Middle East & Africa	UAE Central, Qatar Central, South Africa North, Israel Central
China (Sovereign)	China East, China North (operated by 21Vianet)
US Government (Sovereign)	US Gov Virginia, US Gov Texas, US DoD Central

Table: Summary of Azure geographies with sample regions. Each geography meets data-residency requirements.

Azure Regions (and Region Pairs)

An **Azure region** is one or more datacenters deployed together to provide local Azure services. Microsoft now has *60+ regions* worldwide. Each region provides common Azure services (VMs, databases, networking) with local low-latency access. Many regions have **Availability Zones** (typically 3 independent zones per region) to protect against datacenter failures. Other resiliency comes from **region pairing**: Azure statically pairs certain regions within the same geography. For example, *East US* is paired with *West US*, *North Europe* with *West Europe*, *Central US* with *North Central US*, and so on. Region pairing gives these benefits:

- **Priority Recovery:** In a complete outage, one region in each pair is prioritized for recovery.
- **Staggered Updates:** Microsoft deploys platform updates to paired regions in different order, reducing the risk of correlated failures.
- **Compliance:** Paired regions reside in the same geography (typically the same country/region) so data residency laws are respected.

Despite pairings, most Azure services can replicate to *any* region. Many newer regions (especially those with rich Availability Zone support) are listed as **nonpaired**. In these cases, zonal redundancy often provides the durability that pairing would otherwise offer. Whether you choose paired or nonpaired regions, architects must design their own high-availability and disaster-recovery strategies rather than relying solely on the pairing mechanism.

Region Name	Geography	Paired Region	Zones
East US	Americas (USA)	West US	Yes (3)
Central US	Americas (USA)	East US 2	Yes (3)
West Europe	Europe	North Europe	Yes (3)
Southeast Asia	Asia Pacific	East Asia	Yes (3)
South Central US	Americas (USA)	North Central US	Yes (3)
Japan East	Asia Pacific	Japan West	Yes (3)

Table: Example Azure regions with their geography, paired region, and zone support. (Data from Azure documentation.)

Azure Availability Zones

Availability Zones (AZs) are physically separate locations within an Azure region. Each zone has independent power, cooling, and networking, so that a datacenter failure in one zone (or even a localized disaster) does not affect the others in the region. Regions with AZ support typically provide **three zones** (Zone 1, 2, 3) that are close enough for low-latency networking but far enough to be fault-isolated. Azure offers 99.99% SLA for zone-redundant services when deployed across zones. Almost all Azure regions have at least one zone-enabled region per geography, and the number of zones is expanding as new regions come online. When you design solutions for high availability, you should spread resources (e.g. VMs, database replicas) across multiple zones in a region.

In the illustration above, **Regions 1 and 2** both support three zones (each zone is an independent datacenter). **Regions 3 and 4** have no zone topology (they are single-zone regions). When you select a zone-enabled region in Azure Portal, the **Availability options** or **Disks** section will let you choose Zone 1/2/3 for your resources. If a region does not support zones, those options are unavailable and resources will be placed anywhere in that region by Azure. (You can also query zone support via the Azure CLI or the “List of Azure regions” documentation.)

Azure Data Centers

Azure **datacenters** are the physical facilities that house Azure’s servers and networking equipment. Microsoft operates *hundreds* of datacenters in *100+ facilities* worldwide. These facilities are built with multiple layers of physical security (guarded perimeters, biometrics, video surveillance, etc.) and run on energy-efficient, sustainable designs. Each datacenter building contains thousands of servers, storage units, and network switches. In practice, an Azure region (and its zones) consists of multiple datacenter buildings: for example, a three-zone region might have at least three separate datacenter facilities. Microsoft also publishes that its datacenters support thousands of online services. All Azure regions and datacenters undergo rigorous audits and comply with many standards (ISO 27001, HIPAA, FedRAMP, etc.) to meet customer compliance needs.

Azure Portal & CLI Navigation

IT professionals often explore Azure's infrastructure via the Azure Portal or CLI. Some useful walkthroughs:

- **View Global Regions:** In the Azure Portal, go to **Subscriptions** → select your subscription → **Locations (Preview)**. This lists all regions available to you. (Alternatively, run `az account list-locations` in Azure CLI to see all region names.)
- **Identify Region Pairs:** The portal doesn't explicitly show paired regions. Instead, consult the official *Regions List* documentation or use the CLI/SDK. The [Azure regions list] page (Microsoft Docs) includes each region's paired partner. For example, it shows West US paired with East US, etc.
- **Check AZ Support:** While creating a VM or other resource in the portal, select a region. On the *Disks* or *Availability options* step, if the region supports Availability Zones, you will see a choice like "Zone 1, Zone 2, Zone 3." If not, those options won't appear. (You can also check the "Products by Region" page or Azure CLI to see which regions support zones.)
- **Service Availability:** The **Products by Region** web page (on Azure Docs) lets you filter and see which Azure services are available in each region. This is useful to verify that a needed service (e.g. a specific VM SKU or database service) is offered in your chosen region.

Azure Tasks :

- Azure Global Infrastructure Map
- Azure Portal – Region Dropdown
- Azure Portal – Zone Options
- Azure Products by Region Page
- Azure Regions List

Summary Tables

Geography	Example Regions
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Middle East & Africa	UAE Central, Qatar Central, South Africa North, Israel Central
China (Sovereign)	China East, China North (operated by 21Vianet)
US Government (Sovereign)	US Gov Virginia, US Gov Texas, US DoD Central

Table: Azure geographies and example regions (for compliance and locality). Each geography ensures data stays within its boundary.

Region Name	Geography	Paired Region	Zones
East US	Americas (USA)	West US	Yes (3)
Central US	Americas (USA)	East US 2	Yes (3)
West Europe	Europe	North Europe	Yes (3)
Southeast Asia	Asia Pacific	East Asia	Yes (3)
South Central US	Americas (USA)	North Central US	Yes (3)
Japan East	Asia Pacific	Japan West	Yes (3)

Table: Sample Azure regions with their geography, paired region, and zone support. (Region pairings and AZ support are documented by Microsoft.)