**Logical Architecture Diagram**

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**│ ProxMox Host (https://192.168.1.17:8006/) │**

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**│ │ DC01 VM │ │ SQL01 VM │ │ SQL02 VM ││ DC01:****VMSRVDCW2022 (Windows 2022)**

**│ │ (Domain │ │ (SQL Node 1) │ │ (SQL Node 2) ││ SQL01 VM:VMSRVSQLW104 (Windows 2022)**

**│ │ Controller) │ ├──────────────┤ ├──────────────┤│ SQL02 VM:VMSRVSQLW105 (windows 2022)**

**│ │ - 2 vCPU │ │ - 2 vCPU │ │ - 2 vCPU ││**

**│ │ - 4GB RAM │ │ - 8GB RAM │ │ - 8GB RAM ││**

**│ │ - 50GB Disk │ │ - 50 GB OS │ │ - 50 GB OS ││**

**│ │ - AD/DNS │ │ - 100GB Data │ │ - 100GB Data ││**

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**│ Network Layer (192.168.1.0/24) │**

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**│ DC01: 192.168.1.15 │ SQL01: 192.168.1.21 │ SQL02: 192.168.1.20 │**

**│ (DNS Server) │ │ │**

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**│ Cluster & Availability Group Layer │**

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**│ │ Windows Failover Cluster (CL-VMSRVSQLW01) │**

**│ │ - Cluster IP: 192.168.1.30 │**

**│ │-Quorum Witness: \\zamatallica.local\SYSVOL\zamatallica.local\ClusterWitness │**

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**│ │ Availability Group (AG-SQL01) │ AG Listener (LN-SQL01) │ │**

**│ │ - Replicas: │ - IP: 192.168.1.31 │ │**

**│ │ SQL01: VMSRVSQL2019W104 │ │ │**

**│ │ SQL02: VMSRVSQL2019W105 │ │ │**

**│ │ - Synchronous Commit │ - Port: 15666 │ │**

**│ │ - Automatic Failover └──────────┬─────────────┘ │**

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**│ Client Access Layer │**

**│ │**

**│ Applications connect via AG Listener (LN-SQL01,15666) │**

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**Step 1: Plan the Infrastructure**

1. **Virtual Machines (VMs):**
   * **Domain Controller (DC):** Windows Server 2022, 2 vCPUs, 4GB RAM, 50GB disk.
   * **SQL Node 1 & 2:** Windows Server 2022, 2 vCPUs, 8GB RAM, 50GB OS disk + 200GB data disk.
   * **Network:** All VMs on the same subnet with static Ips (e.g., 192.168.1.0/24).
   * ***Shared Storage (Optional):****Not required for Ags (uses database-level replication).*
2. **IP/DNS Plan:**
   * DC: 192.168.1.15, DNS server for the domain.
   * SQL Node 1: 192.168.1.21
   * SQL Node 2: 192.168.1.20
   * Cluster IP: 192.168.1.30
   * AG Listener IP: 192.168.1.31
3. **Domain:**
   * Domain name:  zamatallica.local
   * Service accounts: AdwindomSvc (domain admin), SQLsrvrSvc (SQL Server service account).

* **Step 2: Deploy VMs in ProxMox**
* **Create VMs:**
  + Use ISO images for Windows Server 2022.
  + Assign resources as per the plan.
  + Enable **Hardware Clock** for time sync with ProxMox host.

1. **Network Configuration:**
   * Use a bridged network (e.g., vmbr0).
   * Assign static IPs during OS setup (disable DHCP).

**Step 3: Set Up the Domain Controller**

1. **Install Windows Server on DC VM:**
   * Set hostname: VMSRVDCW2022.
   * Assign IP 192.168.1.15, subnet mask, gateway, and set DNS to itself.
2. **Promote to Domain Controller:**
   * Open **Server Manager** → **Add Roles** → **Active Directory Domain Services**.
   * Promote the server to a DC:
     + Create new forest: zamatallica.local.
     + Set DSRM password.
   * Restart the server.
3. **Configure DNS:**
   * Ensure reverse lookup zone exists for 192.168.1.0/24.
4. **Create Service Accounts:**
   * Open **Active Directory Users and Computers**.
   * Create SQLsrvrSvc (service account) for SQL Server services.
   * Create ADwindomSvc  (add to **Domain Admins** for simplicity).

**Step 4: Configure SQL Server VMs**

1. **Install Windows on SQL Nodes:**
   * Set hostnames: VMSRVSQL2019W104, VMSRVSQL2019W105.
   * Assign IPs 192.168.1.21 and 192.168.1.20.
   * Set DNS server to 192.168.1.15.
2. **Join Domain:**
   * Right-click **This PC** → **Properties** → **Change** → Join zamatallica.local.
   * Reboot and log in with zamatallica\AdwindomSvc
3. **Pre-Requisites:**
   * Install **.NET Framework 3.5/4.8** via Server Manager.
   * Open firewall ports:

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New-NetFirewallRule -DisplayName "SQL Server" -Direction Inbound -Protocol TCP -LocalPort 15666,5022,445,135,80,443 -Action Allow

**Step 5: Install SQL Server 2019**

1. **Run SQL Installer on Both Nodes:**
   * Select **Database Engine Services** and **SQL Server Agent**.
   * Use NT Service\MSSQLSERVER as service account (or SQLsrvrSvc  domain account).
   * Set **Authentication Mode** to **Mixed** (SQL + Windows).
   * Enable **Always On Availability Groups** under **Server Configuration**.
2. **Repeat for SQL02.**

**Step 6: Configure Windows Failover Cluster**

1. **Install Failover Clustering:**
   * On both nodes, via PowerShell:

powershell

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Install-WindowsFeature Failover-Clustering -IncludeManagementTools

1. **Validate Cluster:**

powershell

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Test-Cluster -Node VMSRVSQLW104, VMSRVSQLW105 -Include "Storage", "Network", "System Configuration"

1. **Create Cluster:**

powershell

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New-Cluster -Name CL-VMSRVSQLW01 -Node VMSRVSQLW104, VMSRVSQLW105 -StaticAddress 192.168.1.30 -NoStorage

1. **Configure Quorum Witness (on DC):**
   * Create a shared folder \\DC01\ClusterWitness.
   * Assign permissions to zamatallica\CL-VMSRVSQLW01 (Cluster Name Object (CNO)).
   * Set quorum:

powershell

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Set-ClusterQuorum -NodeAndFileShareMajority \\DC01\ClusterWitness

**Step 7: Configure Always On Availability Group**

1. **Enable AG Feature on SQL Server:**
   * Open **SQL Server Configuration Manager** → enable **Always On** for each instance.
2. **Create Test Database:**
   * On VMSRVSQLW104,15666:

sql

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CREATE DATABASE AO\_DummyDB;

BACKUP DATABASE [AO\_DummyDB] TO DISK = N'H:\Microsoft SQL Server\MSSQL15.MSSQLSERVER\MSSQL\Backups\AO\_DummyDB.bak' WITH INIT;

GO

Copy Backup file to Replica **VMSRVSQLW105**

1. **Restore Database on VMSRVSQLW105,15666:**

Sql

USE [master]

RESTORE DATABASE [AO\_DummyDB] FROM DISK = N'H:\Microsoft SQL Server\MSSQL15.MSSQLSERVER\MSSQL\Backups\AO\_DummyDB.bak' WITH FILE = 1, MOVE N'AO\_DummyDB' TO N'F:\Microsoft SQL Server\MSSQL15.MSSQLSERVER\MSSQL\Data\AO\_DummyDB.mdf', NORECOVERY;

GO

1. **Create Availability Group:**
   * In SSMS, right-click **Availability Groups** → **New AG Wizard**.
   * Name: AG-SQL01, select AO\_DummyDB as the database.
   * Add replicas (**VMSRVSQLW104**, **VMSRVSQLW105**), configure synchronization (Automatic seeding or Full/Async).
   * Create a listener: LN-SQL01, port 15666, IP 192.168.1.31.
2. **Verify AG Health:**
   * Run SELECT \* FROM sys.dm\_hadr\_availability\_replica\_states;.

**Step 8: Test Failover**

1. **Manual Failover:**
   * In SSMS, right-click the AG → **Failover**.
   * Confirm database accessibility via listener.

**Post-Installation Tasks**

1. **Backup Strategy:** Schedule regular backups.
2. **Monitoring:** Set up alerts for AG synchronization status.
3. **Security:** Harden SQL logins and firewall rules.

**Troubleshooting Tips:**

* **Cluster Validation Errors:** Check network/DNS, time sync, and firewall.
* **AG Synchronization Issues:** Verify endpoint connectivity (telnet SQL01 5022).
* **Listener Connectivity:** Ensure the listener IP is pingable and DNS-resolvable.

This setup ensures high availability for SQL Server 2019 with automatic failover in a ProxMox environment.